ENGINEERING NEWS

ABOUT 150 hands are at work on the first section of the Harlem Ship Canal. Two coffer dams are under construction and the work of draining Dyckman's creek will be undertaken as soon as they are finished. A large part of the work on this section is rock excavation. John Satterlee & Co., are the contractors. The appropriation at present available for the work is $410,000. It is to be hoped that the further appropriation necessary for the continuance of the work may get through Congress rapidly enough to save the enterprise from the long delays usual on our public works.

THE Philadelphia Heating Company has applied to the City Councils for a franchise allowing it to lay and maintain conduits for supplying steam to the district lying between Arch and Pine Streets and between Fifteenth Street and the Delaware River.

HERMAN SCHUSSLER has notified the Aqueduct Commission of his inability to serve on the Board of Experts appointed to consider the plans of the Quaker Bridge dam, and WILLIAM F. SHUNK has been appointed in his place. The other members of the Board are JOS. P. DAVIS and J. J. R. CROES.

THE ordinance now before the Philadelphia City Councils in reference to the new Reading Terminals provides that the structures described are to be begun within 6 months and completed within 3 years from the approval of the ordinance. The structure is to be of stone, iron or brick, and must have a clear headway of at least 13 ft. at every street crossing except Broad Street, where the headway is to be greater, 15 ft. at Lehigh Avenue crossing and 19½ ft. at Pennsylvania Avenue. Between Girard Avenue and Brown Street and upon Noble Street and Pennsylvania Avenue the structure is to be built on iron columns resting on stone foundations, the outer edge of the cap stone being on the curb line. Such changes are to be made in existing street grades as to aid in securing the necessary headway and to do away with some of the existing grade crossings on other lines of the Reading road within the city limits.

IT is said that the St. Clair tunnel, between Sarnia and Port Huron, Mich., will cost a quarter of a million dollars. A small part of the material and much of the machinery for its construction will come from the United States; but the most expensive item, the cast-iron plates for lining the tunnel, will be made in Canada. It is reported that no duty will be required on articles made in the United States or Canada for use on this work.

A DECISION on street work, of importance to contractors, has been made in San Francisco by Judge MAGUIRE in the case of C. B. WILLIAMS against JOHN F. SULLIVAN to foreclose a contractor's lien for improvements, the defendant owning property fronting on the street where the improvements were made. A part of the work was finished and approved by the then Street Superintendent. The remainder of the work included in the contract was finished about a year later, and this part was separately approved by the new Superintendent. In the interim the part of the work first completed became dilapidated, but through no fault of the defendant, nor did he cause delay in the completion of the work.

The Judge decided that the work was not done, prior to the commencement of the suit, to the satisfaction of the Street Superintendent, because the contract was single and entire, and the contracts of the property holders in regard to payments related to the whole work, and not to a part of it. It was evidently intended that the work was to be examined as a whole by the arbiter.

THE Mexican Internal Improvement Company has been incorporated in New Orleans, La., by GEO. P. AGAR, N. D. WALLACE, ALPHONSE PHILIPS and FRANK RODER, with a capital stock of $1,000,000. The object of the company is "to construct, operate, maintain and promote various works of public improvement in the Republic of Mexico." Such works include railroads, canals, plank roads, toll roads, bridges and ferries, water-works, gas works, electric lighting plants, etc.

ACCORDING to the London *Times* an advance in lighting railway trains by electricity has been made on a train on the Midland line between Derby and Manchester. The arrangement is that of Mr. ILLIUS A. TIMMINS, and consists of 10 storage cells placed under each carriage. These batteries weigh about 4 cwt. each, and when necessary are charged by a dynamo at the Derby station; they supply a current of 5-candle power to Swan glow lamps. The lights are controlled from the guard's van. By an arrangement of magnets whenever a carriage becomes detached from the controlling circuit, the lamps are lighted, or if already lighted, they remain so. This enables the guard to keep the lamps off when they are not needed, while in case of a breakaway, they are automatically lighted. There is a third circuit, the signaling circuit, by which communication is established between the passengers and the guard. There is no wasting of batteries when the lamps are not lighted. The cost of lighting a train of about 12 carriages is said to be equal to the consumption of half a pound of coal per mile, an estimate which we cannot but think is too rose-colored; but trials between Derby and Manchester are said to have given very satisfactory results.

THE Canada Atlantic Railway Company has brought a suit against the firm of Stanton & Co., contractors, and claims damages to the amount of $1,000,000, as recompense for the injury to its credit and business caused by the injunction which was taken out by the defendants and which was afterward quashed in the courts.

SERIOUS earthquakes are reported to have ocurred in China in the vicinity of Ship Ping and Kien Shui, which are said to have killed about 2,000 people, injured 3,000, and otherwise caused great destruction.

Two laws of interest to engineers were enacted at the session of the Iowa legislature just ended. One is an act fixing the mode of making sewer assessments. The council shall declare by resolution the necessity for a certain sewer, giving location and size, and notice for 20 days of such resolution shall be given designating a time and place where the property owners may appear and object. Then if the council decides to build the sewer, the city engineer must file at once plans and specifications with the board of public works and let the contract. The board of public works and the engineer shall make the assessment to the lots and file the same within ten days from the letting of the contract. Two weeks notice shall then be given by publication of the time when such assessments shall be confirmed.

The second law gives cities power to compel a railroad company or companies to construct over grade or under grade viaducts for the passage of teams across their tracks, the same to be made in accordance with specifications prepared by the board of public works, and where two or more roads combine to build one viaduct the council may determine the proportions of the cost which each must pay, including approaches. The damages to abutting property are to be assessed in the same manner as when taking possession of property for railroad purposes, but the city must pay all such damages. The railroads cannot be compelled to construct more than one viaduct in any one year, nor place them on streets nearer than four blocks to another viaduct. If revenues are derived by tolls or otherwise it shall constitute a special fund for repairs, and one-half of all expenses of maintenance shall be paid out of such fund or by the city and the other half by the railroads.

THE Kings County Elevated Railway, Brooklyn, N. Y., was opened for traffic April 23. The line, which is one of the most important of the city's rapid transit lines, is only completed to Nostrand Ave., but is being built out to East New York. During the busy hours 4 car trains are run, alternate trains running to the bridge and the ferry. A pusher engine helps the heavy trains up the grade from the ferry. At the curve near the City Hall, an automatic signal is put up; every train in passing sets the signal and it remains at "danger" until the train has passed off the curve to the straight line. This signal is the invention of ROBERT BLACK, roadmaster of the Manhattan Elevated Railway, New York, which road has also adopted it. The engines are similar to the latest type put on the New York elevated lines, and the cars have a very handsome appearance. The engines and rolling stock are painted a very dark brown, which is more pleasing to the eye than the bright brown usually adopted.

AT the Convention of Illinois Highway Commissioners, held recently at Springfield, Ill., a resolution was adopted proposing an amendment to the State Constitution authorizing legislation for the establishment of hard road districts, for the construction of permanent roads and for their maintenance by general assessment within the district, or by special assessment upon the property benefited thereby. E. C. LEWIS, of Deer Park, is President, and O. C. HICKS, of Bushnell, is Secretary.

THE Standard Oil Co. is said to have purchased a large tract of land at Laketon, O., and a tract of 300 acres at Hammond, Ind. It is reported that a large refining plant is to be erected at Hammond. The new pipe line from Lima, O., to Chicago, will require pumping stations at Lima, Huntington, Laketon and Wilder's, although the initial point of the line is more than 300 ft. higher than the terminal point.

THE Birmingham Compressed Air Power Co., of Birmingham, England, has been advertising for the supply of meters for measuring the quantity of compressed air delivered to consumers. The meters will be required of various sizes, to measure from 5 to 500 cu. ft. of air per minute, at a standard pressure of 45 lbs., with compensating adjustment for variations of pressure within a range of 10 to 15 per cent.

THE tunnel into which the Dolores river in Colorado, is to be turned, to irrigate the Montezuma valley, has been completed. It is over a mile long, and will carry water for the irrigation of about 300,000 acres.

THE most serious railway accident of the week was a derailment, April 21, on the New York, Lake Erie & Western Railroad, near Cameron Mills, N. Y. The truck of the engine of a fast freight train jumped the track and the engine and cars were badly wrecked. The engineer and fireman were fatally injured.

IT is reported that a portion of the bank of the government canal at Kaukauna, Wis., was carried away last week, and the rush of water caused some damage to a neighboring factory. Gangs of men were at once put at work to repair the break.

THE Nashville, Chattanooga & St. Louis Railroad bridge (trestle ?) across Grace creek, near Waverly, Tenn., was burnt April 18. It was about 200 ft. long. Traffic was interfered with considerably.

THE railway is extending in classic Greece. An extension of the Pirri-Peloponese line (which is now completed to Patras) from Patras to Pirgos is being constructed; work is progressing rapidly, and it will be completed and ready for traffic by the end of the year. The Government will authorize the construction of a State line from Mirous-Nauplia to Calamata, the line will be about 135 miles long, and will pass across the Peloponnessus; it will be metre gauge, and built in accordance with plans and specifications prepared by French engineers. The Minister of Finance is to issue bonds for 24,000,000 drachmas for carrying out the work. Another projected State line, principally for military purposes, is to connect Missolonghi and Agtinion, it will be about 37 miles long, metre gauge. A Belgian firm has offered to build and equip this line for about $725,000, to be paid in two instalments. To raise this sum the Government proposes to issue bonds of $100 each, with yearly interest coupons of $6 attached the bonds to be paid off in 99 years by annual drawings. The line is to be ready for traffic in 1890.

The Finley Helio-Telegraph.

The first perfected heliograph was invented in 1869, by Mr. HENRY C. MANCE, then in Beloochistan, on the Government Persian Gulf telegraph. As now perfected, his heliograph generally consists of two tripods, two plane circular mirrors, a sighting rod, a horizontal tangent screw, and a cylindrical handle connected by a ball and socket joint with a lever attachment to the revolving plate carrying the station mirror, so that the lever-handle and rod together form a finger key. One mirror throws the sun's rays upon the other, and the second one can be so adjusted as to reflect these rays upon a distant point. By throwing the rays on and off the distant station, and varying the length of projection, the MORSE alphabet can be represented, and messages transmitted. In 1873, Capt. BEGBIE, instructor in army signalling, at Bangalore, India, modified the heliograph by using screens to intercept the reflected rays in place of turning the reflecting mirror.

Other modifications have been introduced, but not until quite recently has the heliograph been used for military purposes. This is shown from the fact that no mention is made of its use in the official records of our late civil war, nor in the Prusso-Austrian, Abyssinian, Franco-German, or Turko-Russian campaigns. Since 1878 the instrument has been extensively used in Europe, and was employed here with great satisfaction during the Indian war of 1886 in Arizona and New Mexico.

The usefulness of the heliograph has been greatly restricted for the following reasons: It can only be used in sunny days, with a comparatively clear atmosphere.

It is very difficult to avoid error in distinguishing between dashes and dots, for in unfavorable weather the flashes are often barely perceptible, and unless they are timed by the operator with great exactness two dots may be taken for one dash. The instrument gave good results in Arizona and New Mexico because the atmosphere there is very clear, but in less favored localities the use of the heliograph for military purposes is often wholly impracticable, as cloudy weather may render it useless for days together when most needed.

The advantages of a heliograph which should overcome all these difficulties were so apparent that Lieut. JNO. P. FINLEY, Signal Corps, United States Army, studied the subject until he invented and perfected an instrument which he claims meets all the requirements of the case, and cannot fail to prove of great use both for military and commercial purposes. This instrument is known as the Finley Helio-Telegraph, and consists of an instrument mounted upon a tripod, with two sets of mirrors, a telescope, screens for obstructing the rays, a register for recording messages received from other stations, lamps for use in cloudy days and at night, and various other apparatus necessary to meet all possible needs.

Reflections from one mirror indicates a dot, from two a dash, and as screens are used to obscure the flashes, the operation of transmitting messages is purely mechanical, in which the receiver can have no difficulty to distinguish between one light and two, and can never mistake a dash for a dot. The receiver observes through a telescope, and has a recorder attached to his heliograph. At night or in cloudy weather, lanterns of peculiar construction are used, so that the instrument can be operated at all times. If desirable, and the location renders this possible, electric batteries, wires and lamps are used, and the operation is reduced to breaking or closing the circuit, according as the case may be. Modifications of the system provide for carrying the whole apparatus on one's shoulders, either while on foot or mounted. It should be said that in night work, sight on the distant station is obtained by adjusting the instrument to the latitude and departure of the opposite station, as determined during the day, a compass for this purpose accompanying each instrument.

The instrument is designed principally for short ranges, but it is provided with extra mirrors which can be used to increase the range.

The details of the new instruments are fully described in a manual prepared by Lieut. FINLEY, and further information can be obtained by those interested from the American Heliograph and Signal Company, Washington, D. C.; JAS. C. INMAN, President. The main features of the instrument are given above.

Lowering the Intake Pipe and Crib of the St. Cloud, Minn., Water-Works.

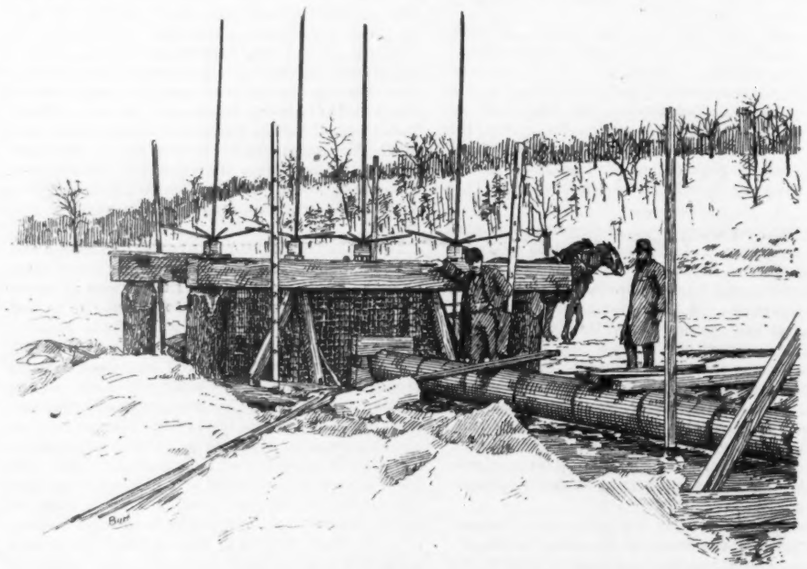
The recent extension of the water-works plant owned by the St. Cloud Water-Works Co. involved the lowering of 747 ft. of 16-in. intake pipe to the bottom of the Mississippi river. This was done in March, while the ice was 28 ins. thick, and the river 10 ft. deep. The designing and constructing engineer for the new works is E. T. ABBOTT, C. E., of the firm of ABBOTT & CHAPMAN, Minneapolis, Minn. We are indebted to Mr. ABBOTT for the illustrations, and for the main facts concerning the operation.

Lowering Intake Pipe, St. Cloud, Minn., Water-Works.

The 16-in. pipe was made from wrought-iron plates by PETER DEVLIN & SON, of Chicago. It was shipped to St. Cloud in lengths of 28 ft. 9 ins., and riveted on the ice in 11 hours time. Piles had already been driven 25 ft. apart to hold the pipe in place when lowered, the attachment being made by means of iron loops.

The 747 ft. of pipe weighed about 36,000 lbs. To lower it, timbers were spiked at an angle to the tops of the piles, which had been left extending above the ice for this purpose, as shown by the cut. Through these timbers, $\frac{7}{16}$-in. iron rods with a 10 ft. thread above were run down vertically and bent around the pipe. There were twenty-four such rods, and they were held in place by a nut on the upper side of the arm through which they passed. The 10-ft. thread extending above the arm and nut, by screwing up all the nuts, the pipe was gradually lowered along its whole length. The bed of the river was practically level, so the pipe rested on the river bottom and against the upstream side of the piles. The latter were sawed off just above the top of the pipe.

The intake crib or cage was sunk in connection with the pipe and by means of 4 rods 1¼ ins. in diameter It rests on 9 piles sawed off just at the bottom of the river. The cage has a floor composed of 5 layers of 2-in. plank, and is 6 ft. square by 4 ft. high, the sides having screens made of ⅜-in round iron with 3-in. meshes. The top screen is made of 1 by 1¼-in. bar iron, with 5-in. meshes. The cage is covered with 80 cu. yds. of small stone which acts as a filter, while holding the cage in place.



Lowering of Crib, St. Cloud, Minn., Water-Works.

The work was done with great quickness, as the pipe and crib were in place 21 days after the first steps were taken, and 19 days after the contract was let for the pipe. In this short time surveys and soundings were made, piles ordered and driven, the crib constructed, the pipe transferred from Chicago, laid on the ice, riveted and successfully lowered. The total cost of the pipe, cage and stone, in place is given as $2,100.

WE learn that there is talk of a cable road in Denver, Colo., on Fifteenth St.

Water Supply Treatments and Sources.

ADDRESS OF PRESIDENT J. T. FANNING AT THE EIGHTH ANNUAL MEETING OF THE AMERICAN WATER-WORKS ASSOCIATION.

NATURAL CLARIFICATIONS.

The first and highest sanitary maxim emphasizes the municipal duty of securing the most wholesome public water-supply and thereafter faithfully protecting the same. If, charged with this duty the municipality goes to the river, the lake, or the hill side stream in search of a pure supply, it will learn that all these waters have their sediments and solutions and most of them have such impurities as will readily catch the attention of even a careless observer.

When the public eye observes, or the public receives a rumor that these impurities are following it from its taps, there is a liability of exceedingly capricious opinion. This capriciousness over real, and more often over supposed, impurities, is one of the chief difficulties with which projectors and managers of water-supply have to contend, and out of it have grown discussions and hatreds and divisions that have almost rent communities asunder.

Sometimes the consumers of water accept a supply graciously when to do so is to endanger their community, and on the other hand lack of funds or probable profit may influence the acceptance of a pernicious source until a change is more feasible.

The waters from mountain streams among the granite hills, though unfortunately within reach of so few villages, are the purest, and are also the clearest waters, except in their floods. Then next, the waters from the gneiss, trap and other unstratified hills, and then upland lake waters are excellent in their flow; but these when gathered in reservoirs exposed to the light, may be as prolific producers of tiny plant life as a newly fertilized lawn. We must store them in darkness and keep their temperature low or they will present a requirement for artificial clarification.

As the hillside streams and waters of the upland lakes abrade their channels and shores and receive the drainage of the midland forests and low-land swamps, they take in mineral and organic sediments, and on reaching the lower valleys as large rivers, there has come the necessity for, in some degree, their artificial clarification to fit them for potable water supplies. For villages and towns not on the upland hills, clarification, in some form, is a result of most exalted importance.

Among the bases of such hills as furnish the best water, are found the best examples of naturally clarified waters in their clear flowing springs.

The villages and towns of the midlands and plains have to create artificial springs, in order to receive the advantages of natural clarification. This they may do in various forms of driven and steamed wells, in filtration tanks and in filtration galleries, but for reasonable success these must be in silicious sands or coarse gravels, so that the flow may be ample and the mineral impregnations slight. Large proportions of soluble minerals in the soils lead to undue hardness in the water and excludes such soils from the availables for infiltration purposes.

The areas of water-sheds of the wells and galleries are controlling conditions, for the rainfall upon each water-shed area, less evaporation, is the true source and measure of supply. The uniformity of continuous flow of this rainfall is governed by the storage capacity of the soil and percolation to the driven well through its water-shed sub-strata. If the gallery and sources of flow are shallow, then the water-shed must be closely scrutinized lest some organic taints be washed down in solution from the surface where the rainfall is gathered.

Three principal conditions of successful infiltration of potable waters are, first, sufficient water-shed; second, pervious receiving and conducting strata; and third, insoluble storage strata. The most successful infiltrations for supplies of towns and the large villages have been into relatively long and narrow galleries, and the purities of their waters have varied according to the nature of the filtering soils.

The mineralogical conditions suggested above indicate in a general way, where infiltration supplies may be sought with a reasonable degree of success. In their most successful use, about one-tenth acre of bottom surface in the gallery has supplied 1,000,000 galls. of water, requiring a gallery, say 8 ft. wide and 540 ft. long.

Granular sands offer the best possible conditions, for infiltration, and are some times available in the islands and shores of lakes and streams. Without the most favorable conditions, the extent of gallery required makes infiltration unavailable to the medium sized and larger cities of the valleys.

DEEP WELL WATER SUPPLIES.

Different systems in the construction of water-works, like styles in architecture, have their respective waves of popularity. Just at present driven and drilled wells are attracting much attention, and all over our land, prospectors are drilling deep for water, oil and gas.

Discussions of the "germ theory" of disease have been frequent of late, in which drinking water from surface sources is assumed to be some times a conveyor of micro-organisms which become lodged in the human system and induce various fevers and epidemic diseases. These have had much influence in leading individuals and villages to seek their water supplies, deep below the habitations of the proptophyta and protozoa, and there is a popular notion in most localities that if a well is only drilled deep enough anywhere, a flow will be the reward, as copious as when Moses smote the rock in the wilderness.

There are localities where an artesian flow of water or oil is a probability, and other localities where the financial expenditure for a test is unwarranted. An intelligent stratiographic study of any locality is the basis of a prediction whether granite, limestone, sandstone, shale or coal will be found in the substrata, and likewise it is the basis on which to found the prediction of the presence or absence of water or oil that will flow with sufficient volume and pressure.

An invariable condition out of which a flowing well may be produced is an inclined, porous or pervious stratum overlaid with an impervious stratum, and the pervious usually overlays an impervious stratum. To illustrate these conditions on a minute scale, take a china saucer and cover its interior with a ¼-in. depth of granular sand and then place within it another smaller saucer covering the sand. Now, if the sand between the saucers be filled and replenished with water to the brim of the inner saucer, by rain or otherwise, and a fine hole be drilled through the lower portion of the inner saucer, then an artesian flow will be the result. Substantially this condition is often found in the sandstone region, and where an extensive coarse granular stratum of stone or of gravel lies inclined between fine-grained stone or clay, and has a broad outcrop at its highest edge, a copious supply of water will be found, and the volume of water it can continuously supply will always be dependent on the replenishing rainfall supplying its higher portion of outcrop, its available water-shed.

This condition cannot be anticipated where the igneous rocks are near the surface or where the rock is fine-grained, as in limestone or slate, unless the rock is badly shattered. Potable artesian water can rarely be anticipated in the bituminous belts, now well defined in the settled portions of our continent, and usually well outlined in the geological maps of our States, and only in this latter may oil and gas reasonably be anticipated.

As with the gallery, so with the artesian supplies we find the extent of available watershed to interpose a limiting condition, and rarely can the medium and larger sized cities of the valleys find an ample deep well clarified supply by searching among the strata. These cities, in order to have clarified water, must employ some form of artificial clarification to improve available surface water supplies. We have already alluded to the usual necessity for such clarification, but when the necessities that grow out of our physical requirements are opposed by municipal financial weakness, the weakness usually proves the stronger.

ARTIFICIAL CLARIFICATIONS.

Sedimentation, precipitation, filtration and aeration of water supplies are subjects that have been ably discussed in these meetings, and some valuable papers relating to these topics are ready for presentation during this annual gathering, so that a mention in outline only, is proper at this time. As in natural clarification so in artificial, the chief objects are the removal of:

1. Mineral matters in suspension, consisting chiefly of silicious and calcareous sands, marls, loam and clay.
2. Dissolving organic matters in suspension, both vegetable and animate.
3. Live organisms, both vegetable and animal, and for a further duty the dissolution of the organic and mineral solutions in the water, including the removal of acquired color and restoration of a due proportion of oxygen.

As incident to the study of clarification of waters attention has been drawn to the forms of aquatic life that lead to the chief necessity of such treatment. We have observed that the clear mountain streams held in storage, and pure waters generally if exposed to light and summer warmth develop certain of the fresh water algæ with rapidity, and of such plant life the desmids take most kindly to the pure water. They are harmless while thriving, but if abundant give odor and opaqueness to the water as they decay.

The oscillatoria and confervæ incline to waters with calcareous impregnation and are indicative of hardness to some extent. The bacteria are of the lowest group of algæ, and incline to waters having organic pollutions, and these are the microscopic plants we are taught most to fear. Their presence has been believed to be invariably associated with the putrefaction of decaying animal and vegetable matter and their tenacity of life is not less remarkable than that of the lowest forms of animal organization. Dr. COHN distinguishes two classes of them present in the ferments of putrescence, a color-producing class and a disease-producing (pathogenous) class.

The term "microbes," as used in our literature of water analysis, includes both the micro-algæ and micro-fungi. The biological investigations of public water supplies includes the study of the characteristics of the microbes and of the effects they may produce on contact with life and their effects when introduced into the human system.

Among the lowest forms of animal aquatic life the spongilla has proved most offensive in the odors it gives to our natural lake and impounded waters. The tiny infusoria and polypes sometimes develop in superabundance, and in their decay make an objectionable water pollution. The pollutions most apparent to the naked eye, other than mineral sediments, are the washings of forest and field, dissolving into a fibrous condition, and the pollutions harboring most dangers are the several classes of sewage in processes of dissolution and in solution.

Dilutionand agitation are Nature's remedies for natural pollutions, but humanity has counteracted the remedy where it has built its gardens, factories and towns more numerous and dense as the water grows slacker along its course through the valleys to the sea.

The remedy which has been most extensively tried and most discussed in these meetings is sand filtration, and you are familiar with the construction of sand filters. Among the best surfacing materials for these are fine grained silicates of soda, the granitic sands, and with these are mixed at time granular iron and especially the magnetic carbide of iron and charcoal, and prepared silica-carbon and charcoal plates have also been used. These filters do excellent service if they are cleaned as often as excellent service demands, which is very often for a turbid water. If not duly cleaned they may clarify water for a time, in lessening degree, until the filter is so foul with intercepted matter as to finally pollute the flowing water. Uncleaned and unærated filters, public or private, are an abomination and a danger.

Sand filters for public supplies require four-tenths of an acre of surface for each million gallons per diem. capacity, and cost from $50,000 to $80,000 per acre for original construction. In Northern cities the accumulation of anchor ice on the surface of the sand, and ice on the surface of the water, interferes with the use of such open filters, and under favorable conditions the cost of filtration of turbid waters will not be less than $2.50 per 1,000,000 galls. of water filtered.

The water ought, if possible, to be prepared for either public or private filtration by sedimentation, if it carries much sand or coarse sediment, and by precipitation if it carries much fine clay or organic matter in suspension, mineral or organic matter in solution, or contains undue proportions of aquatic life, so that the filter may be relieved of excessive

work, clogging and pollution, and may be thoroughly cleaned with ease.

Various precipitants are familiarly known and used in the processes of the arts, including salts of many of the metals. For instance: the sulphates and per-sulphates of iron, copper, manganese, zinc, alumina, potassa, lime, and the chlorides and per-chlorides of iron, tin, aluminum, magnesium, calcium, etc. Hydrated aluminum chloride (sugar of lead) and alumino-ferric compounds have had large applications, and iron filings, scraps and bundles of wire have been used in the purification of water polluted with vegetable organic matter in process of dissolution. Alum, lime and iron have long been used for precipitants by families whose household supplies of water came from the clay carrying rivers or the dark stained upland lakes. The sulphates of metals should, however, be used cautiously where they are liable to contact with organic dissolutions, as they may be converted into soluble sulphides and disengage sulphuretted hydrogen.

For the water supply of a large city natural sedimentation, by rest of the water in settling basins, is a slow process, excepting for the coarse sands and heavier sediments, and requires large and costly basins in which to give the water six to twelve days rest before it is passed into the distribution system. With the proper and continuous use of precipitants as much may be accomplished in the same number of hours with great saving in cost of settling basins. Some of the precipitants have such affinities for organic matters in dissolution, and clays in suspension, that they almost instantly unite with them in coagulating flocculent masses, and are so concentrated that they have sufficient specific gravity to promptly start them journeying downward to the basin floor In this movement of the flocculent material clarifying the water, the micro-organisms in the midst of the organic pollutions are largely caught and borne downward. In the coagulations are caught much of the impalpably fine organic matter, and also the microscopic plants that give color or opaqueness or turbidness to the water. At the same time the dissolving organic matters that are thrown down to await the periodical cleaning of the basin floor are rendered less soluble by their contact with the metallic salts, which, with exclusion from the air, hinders their further dissolution. The basin floors ought to have frequent and thorough cleanings. Those pollutions in the water that incline to resist precipitations are common salt, urea, ammoniacal salts, salts of the alkaline earths, oils and refuse similar to that from gas works. As nitrates and nitrites are not fully controlled by the precipitants economically available, it is evident that precipitation is not a permanent guarantee against later putrefaction in the water if it is afterwards exposed to light and warmth of the summer sun, but the tendency is lessened by reduction of its cause. Limey waters are alkaline and there is more tentency to active putrefaction in alkaline than in neutral or acidulated waters. Then we are to observe that the salts of iron, if used in excess, give colors to the water ranging from greenish yellow to black; for instance, contact of iron with sulphur gives a very dark brown tint.

For water supply clarification purposes, solution of iron, aluminum and calcium are the precipitants most economically and commercially available, and they are used alone or in varied combinations according to the character of the sediments and pollutions to be acted upon. Very small proportions, comparatively, are effective and the precipitants themselves are so completely carried down with the precipitated matters that bare traces of the former remain in solution in the water.

Precipitation is an intermediate treatment between the more common processes of sedimentation and filtration, and it reduces materially the time and cost of unaided settlement, and area of settling basins. The precipitants are easily introduced, for they may flow from the faucets of one or more small tanks placed above the inlet stream of the settling basin, and thus be intimately intermingled with the waters.

In preparing an iron solution for clarifying the muddy water of the Mississippi, at New Orleans, our honored ex-President has treated red hematite iron ore with hydro chloric acid, bringing it to 1.5 specific gravity, and his experiments showed that one part in 20,000 clarified the muddiest water of the river, and neither hardened the water or left any trace of iron therein.

In every case where filtration is desirable, preliminary preparation by precipitation is important, and in very many cases where sand filtration on the older system is, for financial or other reasons impossible, precipitation will greatly improve the water supply, and private filters on the services of such as can afford them can complete the process in that portion of their waters that are devoted to culinary and drinking purposes.

With precipitation most waters will be fully fitted to enter the distribution pipes, and in the filtration that follows as a separate treatment the filters will be greatly relieved of those organic matters that soonest clog and pollute them, and the trouble of such frequent cleanings as public or private filters must have, in any event, will be lessened, and the thoroughness with which they may be cleaned will be much enchanced. After precipitation or filtration the waters should be kept well covered and it is advisable that they shall not be kept in storage long enough for the slightest remaining organic matters to again reach a condition approaching objectionable dissolution.

Aeration, which will restore to the water an abundance of oxygen, is a most excellent treatment and antiseptic after precipitation and filtration. This is simply accomplished by forcing air into the pumping main, or letting it be drawn into the suction chamber of the pump, or into the supply main from the reservoir.

PROTECTION OF SOURCES OF WATER SUPPLY.

Glancing over a map of the water courses of our country, we observe that the towns and cities designated thereon are generally on the shores of those streams where water-power encourages their growth, or facilities for commerce increase their wealth. The streams are the natural sewage channels of their water-sheds, and the water supplies taken therefrom suffer according to the densities of the population, and the extensiveness of the manufactures and agricultural productions along their courses. To prevent the establishment of mills, with their accompanying villages and gardens, along the rivers will, to some extent, interfere with local and national prosperities, and to entirely prevent the sewage of the upper villages from flowing down to the cities of the lowlands will, in a measure, interfere with natural laws.

We are not adequately handling our water supplies by simply filtering out such pollutions as may chance to come down to us, but ought to begin our purifications by attacking the pollutions themselves where they originate and providing that they shall, so far as possible, be first spread broadly on the lands, and there precipitated and clarified by Nature's laboratory processes.

Except in the mining and bituminous districts and alkali plains, we need rarely fear the mineral impregnations that nature sends down in our water supplies. It is the vegetable organic, and especially the sewage organic matters in dissolution that we have most to fear, and these multiply as the populations increase. It is in the midst of these that the disease inducing germs chiefly generate. The desmids and bacteria of the purer waters, though frequently abundant, are not proved, nor yet fairly accused, of endangering human constitutions, though absorbed through the medium of water supply.

The local water-sheds have their duties, each for itself, to meet and handle this phase of the problem. The United States has now a total population of about 60,000,000 people. Our past rates of decennial gain have been:

1840 to 1850	35.81	per cent.
1850 " 1860	35.57	"
1860 " 1870	22.62	"
1870 " 1880	30.07	"

The increase is most rapid in the towns and cities where the systems of water supply must be public in their character. Eighty per cent. of the population of the State of Massachusetts, for instance, is already so grouped as to be provided with public water supplies.

The rapid gain in population, the concentration of the people in towns, the increase in number of towns and in new water supply systems, all significantly suggest a united action looking to the matter of protections of the sources of additional water supplies for existing towns, and of new supplies for future towns. This is a question that seems to loom up before us as though it might soon assume even national importance, and may in the early future tax the highest resources of statemanship and most exalted wisdom. The matter is worthy the earnest consideration of the American Water-Works Association.

The Sanitary Protection of the Water Shed Supplying Water to Rochester, N. Y.*

BY J. NELSON TUBBS.

The water for a domestic supply for the city of Rochester, N. Y., is obtained from a natural lake, situated about thirty miles southerly from and at an elevation of 388 ft. above said city. The lake is about seven miles long and five-eights of a mile wide. It occupies the northern extremity of a deep, narrow valley, which is fifteen miles long. In the southern part of the valley is situated the village of Springwater, having a population of about 600. The shores of the lake are bluff and steep, rising to a height of from 300 to 500 ft., and mostly covered with a growth of timber. The basin of the lake is deeply excavated in the formation known as the Marcellus Shale, lying above the limestone rock of that region. In the Springwater valley, south of the lake on the summits of the bluffs forming the boundary of the basin, are a considerable number of farms. The wildness of the scenery, the purity of the water and the healthfulness of the situation has attracted a considerable summer population, amounting to from 500 to 700 persons.

The necessity for the efficient sanitary protection of this water shed was self evident. Obviously the ideal method would be the purchase of the lake and its whole water shed and the removal therefrom of every habitation or shelter for man or domestic animal, including all farm and village constructions and improvements, and to restore the whole area to a state of natural wildness and savagery. The objections to this plan were its enormous cost, the city whose population is 30,000, having already spent $4,000,000 on its water supply. Also that the lake is a navigable body of water whose title could not be vested in private or corporate hands.

The plan which was finally adopted, was as follows:

The Legislature of the State passed an act conferring upon the State Board of Health power to protect from contamination, by suitable regulations, the water supplies of the State and their sources. Under the provisions of this act the State Board of Health is empowered to enact regulations for protecting from contamination any public supplies of potable water, with provisions for the enforcement of the regulations and the inspection of the water sheds of streams supplying water for public supplies, to discover offenders against the regulations.

Under this act the State Board of Health established rules and regulations for the sanitary protection of the waters of Hemlock Lake, providing in substance as follows: That privies, pig-pens and barnyards shall not be located over or adjacent to any stream, spring, or dry water course where the contents thereof can reach the same. That any privy situated within fifty feet of any spring, stream or dry water course, or ravine, shall be constructed without a vault, and shall have under the seats water-tight receptacles for night soil, which shall be frequently removed, emptied, cleaned and returned, and the contents buried in the earth in such a manner that they cannot by any possibility reach any water course or permanent level of subsoil water. That no manufacturing waste be discharged or drained into any spring, stream or dry water course on said water shed. The same restriction applies to the depositing of dead animals, birds, fish, decayed fruit, leaves, sawdust, roots, branches or trunks of trees in any spring, dry water course, or into the lake itself. The washing of sheep or other animals in the lake or any of its tributaries is also prohibited.

The provisions relating to houses, cottages, tenements, tents and picnic grounds within 200 ft. of the shores of the lake may be summarized as follows: Each is to be furnished with at least one privy set upon the surface of the ground, without a vault, and so constructed that metallic pails fifteen inches high by fourteen inches in diameter, can be placed under the seats and easily removed with their contents. The occupants are required daily to add dry loam in small quantities, as a deodorizer and absorbent. It is made the duty of the occupant also, to provide a receptacle for dry garbage and to carefully place the same therein. All slop or wash water to be scattered upon the surface of the soil at a distance from the lake, or any ravine or water course and the points at which said slops are deposited to be frequently changed. Animal manures from stables are required to be carefully deposited in tight covered receptacles and the contents thereof to be frequently removed.

The City of Rochester is required to furnish a suffi-

*Paper read at the Cleveland Convention of the American Water Works Association, April 18, 1888.

cient number of metallic pails for the use of each necessary privy within 200 ft. of the lake and is required to remove, empty, cleanse and disinfect the same as often as is necessary. When a full pail is removed an empty one is to be supplied in its place. The pails during removal are to be provided with air-tight covers, so that no odor shall escape. The contents of the pails, together with the dry garbage, is required to be removed by the city to a point below the foot of the lake and there buried.

As soon as possible after these rules were established the city commenced operations thereunder and has continued the same since that date, a period of three years.

In practice, the night soil and garbage is collected and removed to the foot of the lake by means of a broad, flat bottom steamboat, the collections being usually made in the early morning. From the steamboat landing the night soil and garbage has heretofore been transported on wagons to the dumping ground, which is a plat of land owned by the city in a retired location 1,800 ft. below the foot of the lake. It is intended soon to construct a tramway between these points, so that the transportation may be done on a platform car, the cans being unloaded directly on the car.

The treatment of the night soil and the garbage, on its arrival, is as follows: Narrow trenches are excavated, care being taken that the permanent level of subsoil water shall not be reached, and the contents of the pails are deposited therein in thin layers. It is then immediately covered with dry loam to a depth of about six inches. This process is repeated day by day until the trench is nearly filled, when the balance is rounded up with earth. A measurement of the location of these trenches is made and recorded, the surface cultivated and cropped, and after a suitable period the same land may be again used for a like purpose. A trench 500 ft. in length has proved entirely sufficient for a single year's operation up to the present time, and as these trenches need not be more than three feet apart, it will be seen that but a small area need be provided for the purpose.

The cans, as fast as they are emptied, are taken to the sanitary building, which is provided with an elevated tank filled with a solution of copperas, and also all other necessary appliances for washing, cleansing, deodorizing and drying the cans. The cans are of heavy galvanized iron, and are thoroughly coated, inside and outside, with a coating of black asphalt varnish. In the cleansing of the cans, if found necessary, other and more active deodorizing and disinfecting agents are employed. The process has been so conducted for the past three years that all local prejudice has subsided and all fears as to possible offensive odor in the neighborhood allayed. In the sanitary building and about the grounds no offensive odors are discernible, although during the past year the contents of nearly 6,000 cans were thus removed and treated.

The results that have been accomplished by these plans are most gratifying. A great proportion of the residents about the lake have become enthusiastic over the idea of keeping their grounds in the neatest possible condition and in maintaining the sanitary purity of the water up to the highest standard. Underbrush, logs, limbs of trees and decaying vegetable growths are no longer thrown into the lake, nor allowed to litter the shores, but are carefully collected and burned. Privies, pig-pens, etc., away from the lake, but on the water shed, have been removed from streams, ravines and dry water courses and placed under such sanitary regulations and espionage as to render them unobjectionable. The local boards of health have become interested in these questions and their co-operation secured. Animals which die upon the water shed, and decayed putrescible matter of all kinds are no longer discharged into the nearest ravine, but are buried in the ground a distance therefrom. And finally, all night soil and dry garbage produced about the lake is collected and buried a long distance below the lake.

The limits of this paper will not allow me to enter into further details. I have in the briefest way attempted to outline the results of an experiment in the sanitary protection of a large water shed under unusually difficult conditions. This has been done with the knowledge on my part, derived from personal observation and from conversation and correspondence with the officers in charge of water works in various parts of the country, that there is an imminent necessity for the sanitary superintendence and protection of many water sheds all over the continent. The plan herein briefly described, or one somewhat similar, may and probably should, with proper modifications to meet varying conditions, be applied to many of the sources of the supply of potable water in this county. When judiciously adapted and applied, it can be operated at comparatively small expense, and will add immensely to the sanitary safety of the water supply.

Allow me, in conclusion, to suggest that this plan of disposing of night soil and other putrescible matter, is Nature's own, simple, effective and yet most wonderful method, and that the nearer our methods coincide with her beneficent and wonderful processes the more surely will human effort be crowned with success. The members of this society, perhaps better than any other class of men, have knowledge of the fearful rapidity with which the natural water courses of the country are being fouled and the waters rendered unfit for potable or manufacturing uses, as well as made potent factors in the dissemination of zymotic diseases by the general discharge of the sewage of towns and cities into the nearest streams. The result of this practice is that not only the large cities, but even small towns, are required to seek remote and expensive sources of water supply, when abundant never failing supplies of water are flowing through or near their corporate limits, originally of unexceptionable purity, but now become the sewage carriers of every city and village along their course. As populations multiply and the demand for pure potable water increases, shall we not be compelled to abandon this pernicious system and return to and copy Nature's processes for rendering putrescible substances not only innocuous, but beneficent, by employment of the wonderful chemical and assimilating properties and possibilities of our Mother Earth?

In the discussion which followed, Mr. TUBBS stated that the cost to the city of the plant at the lake was $5,000 or $6,0000. The annual expense of operating is about $1,500. The City of Rochester itself is now working toward the establishment of plans for the disposal of its sewage upon agricultural lands.

The fact was referred to that several other States, notably Massachusetts, had passed laws of the same import as the New York law and the need of them in many parts of the West as well as in New England was commented upon. This question and the disposal of city sewage are intimately connected and it was deemed the duty of the Association to take a prominent part in aiding to bring about needed reforms

The Use of Salt Glazed Vitrified Pipe in Water-Works Conduits.*

BY STEPHEN E. BABCOCK, C. E.

It having been my lot to construct two quite extensive systems of gravity water-works within the last six years, one at Amsterdam, New York, costing $285,000 and the other at Little Falls, New York, on which I am now engaged, costing $300,000, and in both cases the source of supply being so far distant that the use of cast-iron pipes for conduits would have rendered the construction on the gravity plan almost practically prohibitory, as the additional cost would have placed too heavy a burden on the tax payers—at least they would have fancied so—my attention was called to the use of salt-glazed vitrified pipe as a substitute for iron; as also in rebuilding the conduit at Johnstown, New York, which was done during the time stated. In each case I have successfully constructed the conduit of vitrified pipe, and all of them, to this date, have not required one dollar's repairs, but are actually in the same condition as when laid, all having been in constant use from date of completion.

DESCRIPTION OF AMSTERDAM CONDUIT.

The water supply at Amsterdam is six miles distant and consists of three small mountain streams which I successfully diverted, by vitrified pipe conduits and open chahnels, into one. From this point I brought them across the country to the channel of a summer dry stream, upon which, at a point near the city, I built a combined storage and distribution reservoir. The three mountain streams were known as the McQueen and Rogers streams, and the dry stream as the Bunn creek. There are two intervening ridges, or divides, between McQueen and Bunn creeks, necessitating heavy cutting to divert the water.

McQueen creek is dammed by a substantial masonry structure at a point just below the junction with the West Branch, the dam being 4 ft. high; the channel of McQueen creek was widened and deepened for about 1,000 ft. back; a new open channel or reservoir was excavated in direction of line to Bunn creek for about 800 ft., and until the excavation represented a cut of 7 ft., to allow a sufficient depth of soil to cover the conduit and protect the same from frosts. At this point of termination of open channel, a substantial masonry inlet-chamber was designed and constructed, having suitable iron racks and fine screens, with bulkhead gate to shut down the water. From this point a vitrified salt-glazed pipe conduit, 18 ins. in internal diameter, has been laid to a suitable point to empty the waters of Rogers, West Branch and McQueen creeks into Bunn creek. The pipe is of the pattern known as hub and spigot, and is laid with Portland cement joints. The conduit is laid upon the true hydraulic grade line, excepting two or three points of depression, where it has been necessary to depress from 1 to 2 ft. to admit of sufficient covering of soil over the pipe without changing or embanking up above the original surface of the ground. The conduit is laid to a grade with a total fall of 18 $\frac{15}{100}$ ft. for 10,361 ft. From this point the surface of the ground is precipitous in direction of Bunn creek, having passed now through the second divide, and a 12-in. vitrified conduit is laid down to the channel of Bunn creek with a fall of 38 ft. in 1,000 ft. The conduit has a capacity, when running full, of 2,851,300 galls. per diem, being in excess of the amount which may be expected from the Rogers, West Branch and McQueen creeks. Rogers creek is dammed up by a similar masonry structure 4 ft. high; the water is then diverted and carried easterly in an open channel through about 1,000 ft. of low undulating ground to the west edge of a road. At this point a masonry inlet-chamber, similar to the one on McQueen creek, is constructed, and the water is passed through a 15-in. vitrified salt-glazed pipe conduit 1,500 ft. long, emptying into an open water channel of the West Branch. The water of Rogers creek then passes down the channel of the West Branch, and both empty into McQueen creek at a point above the dam upon the same. From the end of vitrified pipe conduit on Bunn creek the water flows in the open channel of Bunn creek two miles to the storage and distribution reservoir of 100,000,000 galls. capacity.

DESCRIPTION OF LITTLE FALLS CONDUIT.

The conduit at Little Falls is a much more elaborate affair. The water supply is a mountain stream known as Beaver creek. It lies due north from the village of Little Falls, and is distant about 11 miles by road from Main street or center of the village.

Beaver, as well as Spruce creek, into which it empties near the point of diversion, is a tributary of East Canada creek; the line of Beaver creek runs about due east. The ground lying between Beaver and Spruce creeks and Little Falls is depressed by two streams, Gillet and Cathaticane, or Crum creek, both running southeasterly, Gillett creek emptying into East Canada and Cathaticane, or Crum creek, into the Mohawk river, and dividing the intervening ground about equally into four sections, or two divides and two basins or depressions.

I have utilized vitrified salt-glazed stone-ware pipe wherever I could locate the lines to a hydraulic grade line or line of no pressure, and in the two depressions or valleys where the conduit is under pressure, substituted cast iron pipe, crossing the same up to the ground called for by hydraulic grade line of no pressure, produced.

Beaver creek is dammed by a substantial masonry structure at the point of divergence. The dam has a spill-way 50 ft. wide and floods 0.75 of an acre. The dam is 6 ft. high; the south abutment of the dam is formed into a receiving chamber and inlet of conduit line, and is provided with a moveable inlet weir, which may be raised or lowered to allow any quantity of water up to the capacity of conduit to flow into the chamber and thence into the conduit; the saddle of the dam is 2 ft. above the top of conduit. The water starts off from the receiving chamber in a 20 in. iron conduit pipe for 50 ft. to take the first shock off the water acquiring its velocity; it is thence continued with 20 in. vitrified salt glazed stone-ware pipe for 10,000 ft., grade 8 ft. to the mile, the line following the contour of the ground required to give the necessary fill on top of pipe to protect the same, and to insure its lying in natural and not artificial ground. Here a heavy sand cut is encountered for about 1,000 ft. From this point, as a heavier grade can now be given, 18 in. vitrified pipe begins and continues 9,400 ft., grade 13 ft. to the mile, to the edge of the basin of Gillett creek; from here the line is continued with an 18 in. cast iron pipe 6,200 ft. long, which follows along surface or contour of the depression of Gillett creek, rises up to the southerly side of said depression, and ends at a point at which the hydraulic grade line produced would give natural ground to start off with vitrified pipe again.

Vitrified pipe starts here, 18 in. diameter, and is carried along on the hydraulic line to the beginning of the depression of Cathaticane, or Crum creek, 9,100 ft. From this point 16 in. iron pipe 9,400 ft. long, grade 32 ft. to the mile, is used across the depression and up to the top of divide, the southern shed of which runs to the village of Little Falls. From this point 15 in. vitrified pipe is again used for 900 ft., grade 79 ft. to the mile; then 12 in vitrified pipe is used for 1,000 ft., grade 105 ft. to the mile; the conduit proper stops here, a total distance of 8 $\frac{7}{10}$ miles.

The essential points in the specifications for the salt-glazed pipe which I adopted are as follows:

LITTLE FALLS WATER-WORKS—SPECIFICATIONS FOR SALT-GLAZED VITRIFIED PIPE.

The pipe shall all be of the best quality of salt-glazed vitrified stone ware pipe. All shall be of the kind known as "hub and spigot"? The pipe shall have a thickness of one-twelfth the diameter of the pipe. (This it will be observed, is heavier than the ordinary commercial pipe.)

The hubs or sockets shall be 3 ins. deep to the main pipe. (At Amsterdam I used the ordinary depth of

*Paper read at the Cleveland Convention of American Water-Works Association, April 17, 1888.

socket, which is two and one quarter inches, but at Little Falls increased the depth to 3 ins., my experience convincing me that the increase would make easier and more satisfactory work.) All hubs or sockets must be of sufficient diameter to receive to their full depth the spigot end of the next following pipe, without any chipping of either pipe, and shall have a space or joint room of not less than three eights of an inch in width all around for the cement mortar joint.

All pipes supplied shall be moulded under pressure, and the socket of every pipe shall be pressed on or formed with the body of the pipe, and care shall be taken that the sockets are truly concentric with the pipes. All pipes shall be cylindrical, and the spigot end of every pipe shall fit into the socket, leaving the thickness of joint not less than that specified. Five per cent. will be the allowable inspection divergence of the greatest from the least internal diameter, in departing from a true cylindrical cross section.

The pipes shall be well glazed all over. All pipes not well or uniformly glazed will be rejected. All pipes not perfectly burned will be rejected. All pipes having any fire cracks which the engineer of said water-works shall consider injurious, shall be condemned and their places supplied by other pipes. All pipes having transportation cracks shall be peremptorily rejected.

All pipes having blisters which the engineer of said water-works shall consider injurious, shall be condemned and their places supplied by other pipes. All pipes having excrescences or iron pimples in the interior of the pipe, which in the opinion of the engineer aforesaid may impede the flow of the water, shall be rejected and their places supplied by other pipe. All pipe not thoroughly vitrified or fused, or which betrays the use of improper materials or methods in its manufacture, shall be rejected.

If a piece be broken out of the rim forming the hub or socket of a pipe, it shall be rejected, if the length of said broken piece is greater than one-tenth of the diameter of the pipe, measured on the inside face of the hub or socket; provided, however, that the body of the pipe shall be perfect and without breaks or cracks. If a piece be broken out of the socket end of a pipe which shall extend over 1 in. into body of pipe, to sound pipe, or shall be greater in length than one-tenth of the diameter of the pipe, the pipe shall be rejected, and two or more such breaks, either of socket or spigot, shall condemn such pipe, even if both are under the area designated.

SPECIFICATIONS FOR PIPE LAYING.

The excavations in conduit trench, both for iron and vitrified pipe, shall be made to the lines and grades to be given by the engineer from time to time, and in such manner and to such widths as will give ample room for building the structures they are to contain. The conduit will be laid to true grade from end to end of each section of vitrified pipe. The cast-iron portion of conduit shall be laid to conform to the contour of the ground where laid, and trench shall be of such depth as to require a back fill of 3½ ft. on top of pipe when laid.

The joints of the vitrified pipes shall be made of Portland cement mortar, in combination with gaskets of clean, sound hemp yarn or jute, braided or twisted, and tightly driven, as follows:

Each length or strand of the jute shall be of a diameter to loosely fill the width of joint, and shall be thoroughly soaked in a Portland cement mortar, made of a thick paste of clean cement and water, and shall be of a length to go once around the circumference of the pipe and lap over two to three inches. This shall be driven home with caulking tools, and shall be succeeded by a sufficient number of strands to fill the joint-room to within one half an inch of the outside of bell, breaking joints with the laps. All driven home and thoroughly joined together. The joint shall then be finished by filling the remaining one-half inch of joint-room with a clear Portland cement mortar, the joint-room when finished being completely filled all around the pipe to the outside lines of the bells.

The contractor will furnish the pipe layer with a bag, stuffed with shavings or hay, of a size sufficient to fit the pipe, rather tightly, with a rope about ten yards in length fastened at one end to the mouth of the bag. The bag must be placed in the first pipe, the rope passing through each pipe as it is laid down. After the joints are made, the bag is then to be drawn forward at such times before the cement has set as to smooth off and produce a true surface at each cement joint and a continuous thin coating of cement on the lower half of the pipe.

In refilling the trenches, the earth shall be carefully packed and rammed with proper tools for the purpose. Care shall be taken to give the pipe a proper bearing throughout the entire length. The earth filling above the pipe shall be sufficiently packed and rammed to prevent after-settlement, and puddled to the satisfaction of the engineer when so directed.

In rock excavation, the material around the pipe and or 1½ ft. above the same shall be earth, free from stone or rock fragments. The balance of the trench may be filled with such portion of the rock excavation as shall measure not more than 1 cu. ft., provided a sufficient amount of earth be mixed with the same to bond it together like a mortar, and if necessary suitable material satisfactory to the engineer shall be borrowed to make said filling.

For the first hundred feet from the receiving chamber the pipe shall be bedded in a wall of mortar extending all over the bottom of the trench and extending up to pass the center of the pipe, filling the trench completely up to this point. The object and intent of this being to prevent an under leakage at the beginning or receiving chamber end of the conduit.

In order to secure a natural bed for each pipe, the contractor will cause the trench to be excavated down to such depth as the engineer shall direct, by the regular trench gang, to be followed up by a trained gang to dig the additional depth, just to grade as fast as the pipe is laid.

DURABILITY OF VITRIFIED PIPE.

That sound vitrified pipe is itself durable would seem hardly worth devoting much time to demonstrate. Sewers built of it have been unearthed in the excavations of Pompeii and Herculaneum, which cities were destroyed by an eruption of Vesuvius, A. D., 79.

Rev. F. S. DEHASS, late U. S. Consul to Jerusalem, Palestine, writes:

"Vitrified clay is among the most durable materials known. While the marble palaces, temples and tombs of Rome and other ancient cities have crumbled to dust, those built of brick remain almost perfect. The use of terra cotta for images, ornaments, drain pipes, coffins and vessels of different kinds, dates back to the remote ages. Sewers and tiling used in construction, have been found in Pompeii, Troy and Nineveh, also in Ur of the Chaldees, the home of Abraham and the oldest cities in the world. Here it was in general use, and the tombs are drained with clay pipes as sound as when laid in the ground 4,000 years ago.

"The coffins also are of the same material, and of different shapes, some like caskets with lids and others round like bottles, which were sealed up after the corpse was inserted; and there they are by thousands at the present time, sound as when they came from the potters' hands. Nothing is now known more lasting than terra cotta."

Whether the ancients used salt to glaze their pipes with does not appear, but that it adds to the durability of the pipe the following description of the process of glazing will make manifest:

Salt-glazed pipes are necessarily made from good clay, which will stand a great degree of heat. The pipes, after being made and dried, are placed in a close kiln and gradually subjected to an intense heat. When this heat is of sufficient intensity, coarse salt is thrown upon the fire in small quantities; a portion of the salt vaporizes; which vapor, combining with the silica of the clay, produces a soda-salt or glass, which is a glaze and is a part of the body of the pipe. It requires good clay to endure heat of sufficient intensity to vaporize the salt, and this heat is so great that the pipes are thoroughly vitrified and very hard, and glazed inside and out.

DURABILITY OF CONDUIT AS LAID.

As the conduit as laid upon my plan, *i. e.*, laying the pipe to the hydraulic grade line required to discharge the amount of water needed, will always be a line of no pressure, conditions precisely similar to the ordinary sewer as laid, there can be no tendency to rupture or break of any kind due to the water passing through the conduit, and the only danger to be apprehended is from an external pressure crushing the pipe, or to an unequal bearing or settlement of the conduit. The following tests show the strength of the pipe to resist external pressure:

Tests made by Mr. A. V. ABBOTT, Engineer, New York:

A wooden box was made large enough to receive the pipe and allow from 2 to 3 ins. of sand to be packed in at the sides, giving the pipe, as near as possible, the position it would occupy when laid in the earth. The pressure was then put on top of the pipe, with the following results—average of two pieces each size—each piece being 24 in. long:

Diameter.	Thickness.	Crushed at
18 ins.	1⅝ ins.	14,233 lbs.
15 "	1¼ "	24 000 "
12 "	1 "	11,540 "
6 "	⅞ "	28,065 "

Again, the fact is that in deep cuts the filling over the pipe is partially supported by the sides of the cut, the angle of support or repose of the back filling being at an angle of 45° with a horizontal at the top level of the pipe, the earth or back filling forms an arch bridge from this point up, so that the only point to be carefully guarded, is to see that the back filling immediately surrounding the pipe is carefully put in, and that the pipe is laid on the natural ground, so that there may be no undue unequal settlement; and in places where the ground is soft and yielding, to build up with concrete.

RESULTS AT AMSTERDAM AND LITTLE FALLS.

That the results of construction bear me out in this, I have the proof in the actual working of both the Amsterdam and the Little Falls conduits. The Amsterdam conduit is laid generally in very heavy cuts, ranging from 12 to 22 ft. At Little Falls, one heavy cut for 1,000 ft. is in the deepest point 32 ft.; and yet Mr. A. H. DELGRAFF, Superintendent at Amsterdam, writes in every report to date, that there have been no repairs on the conduit.

At Little Falls the upper half of the conduit to Gillet creek has been in use two years, and the whole since July last, and as yet there has not been one dollar's repairs, although on the iron portion we have had three breaks. If the proof of the pudding is chewing the string, I think these two conduits have demonstrated their durability. The same thing holds true of the Johnstown works.

The conduit at Johnstown is about 1 mile long 15 ins. in diameter and similar in construction to the Amsterdam conduit. It has now been in use four years without any repairs.

I desire to call attention to the fact that the use of a bag drawn ahead continuously, after the pipe laying, has the effect of producing a continuous smooth pipe the entire length of the conduit, the small particles of cement mortar which are forced up into the chamber of the pipe in caulking, being smoothed over in the line of the flow of the water, and the joints entirely obliterated. Very careful measurements on a weir at the outlet of the Little Falls conduit showed, when conduit was running full head, a daily flow of 4,250,000 galls., although the calculated capacity was 3,000,000 galls.

To prevent a pressure ever being put on conduit, under no circumstances must any valve be placed in the line, but it must be an open conduit from end to end; the water must be regulated at the head, or by the introduction of a branch pipe with valves on branch, which may then be located at any point at which it is desirable to draw the water off. On the Little Falls conduit I placed branches and blow-offs on each section of the iron pipe at their lowest points.

ECONOMIC FEATURES OF COST.

The most important item in the whole matter, however, is the relative cost as compared with cast-iron pipe. The saving is well worth looking into wherever new works are being designed, or additional supplies added to existing systems, to see if it is applicable to the case in hand.

Taking the actual results of the cost of constructing the Little Falls conduit, the comparative statement, excluding the cost of dam, inlet chamber, etc., common to any plan, will be as follows;

Total cost of conduit, 8$\frac{7}{10}$ miles long.....	$86,085.27
Vitrified pipe portion, 5$\frac{5}{10}$ miles long.....	45,544.43
Cast-iron portion, 3$\frac{2}{10}$ miles long.....	40,540.80

If cast-iron pipe had been used exclusively in place of vitrified pipe, the sizes, owing to the contour of the ground, would still have been the same as were used in the line as actually constructed; the total cost of conduit at contract prices would have been $147,409.29.

If it had been possible to follow on the hydraulic grade line the entire length of the conduit, using vitrified pipe exclusively, the total cost would have been $57,206 64.

the actual workings of the conduits at Amsterdam, Johnstown and Little Falls, I am satisfied that, if properly laid, a salt-glazed pipe conduit is as durable as any that can be laid, as well as being economical, as the above results of actual work show. There being no pressure, there can be no breaks to repair; maintenance is reduced to the minimum.

Yet I think I must state that the application of vitrified in place of cast-iron pipe must be limited to conduits of 2 ft. to 30 ins. in diameter, and to those localities where a line can be run to follow the hydraulic grade line, terminating at a distribution reservoir adjacent to town, which will give sufficient head for the distribution system, or ending at a pump-well.

I believe that the use of vitrified pipe conduits will enable many localities to avail themselves of the better and purer water supplies, that are, without its use, too far distant to be financially available. For example, the Little Falls water is brought at such a moderate cost as to enable them to sell their surplus water at a profit of 5 cts. per 1,000 galls. It would have been too heavy a burden with cast-iron, or at least the taxpayers would have objected to the heavy expense. They probably would have resorted to pumping from the Mohawk river, which takes all the drainage of the cities above them. In the one case they have a pure mountain trout stream of 3 to 4 000,000 galls. flow. In the other they would have had the sewage-contaminated Mohawk river, the constant daily expense of pumping, with no surplus of water to sell.

In answer to questions Mr. BABCOCK stated that the pipe laid at Little Falls was in 2 ft. lengths, and were not underbedded but rested on the bells. The cement was spread in a thin even coating over the whole lower section of the pipe. The Amsterdam conduit was now

six years old, and there had been no breaks or repairs whatever. By following the true hydraulic grade line the pipe was never under internal pressure. There was no trouble in laying pipe in quicksand, soft ground or muck. Rye straw was used beneath the pipe to keep the sand out in such places. In calculating the hydraulic grade (the grade at which the impetus given to the flowing water by the incline is just balanced by the retardation of the current due to its friction) Neville's tables were used, but were found to give discharges about one-fourth less than the actual in pipes of large diameter.

DISCUSSION.

Mr. Holme, Jr.—None of us of course will dispute the durability of salt-glazed vitrified pipe in the building of conduits, for we know it has durability and lasting qualities, but there are certain defects in it which I think have been overcome by the system of constructing a conduit recently used by us at Denver, which is now working very satisfactorily. We have and had some of this work in use for 6 years, which was simply put in as an experiment; we have since built 7 or 8 miles of 36-in. conduit, which has cost us from $1.65 to $2.00 per ft. It will stand a pressure of from 10 to 60 lbs., and we have had it under a pressure of 40 lbs., with no ill results. We have 2½-ft. fall per mile in this conduit which I mention. It is constructed of California redwood, the durability of which I think is equal to that of solid or vitrified pipe. I was sent into California I think about 3 years to look into the durability of California redwood. I travelled up and down the State, visited the redwood forests, saw railroad ties that had been in use 40 years, saw piles that had been driven from 15 to 20 years, both in almost perfect condition, and saw a railroad manager's office that was finished off with railroad ties that had been in use 25 years—they having been sawed into proper form and sizes. We had this redwood sawed in the form of staves, a certain number of staves to the circle. We built our pipe by laying these staves one upon the other and then fastening them together with wrought-iron bands. Indeed, all the staves are bound in this way. The pipe is thus enabled to stand a very heavy pressure. They are placed 3 or 4 ft. apart on the pipe. Since we have had this conduit in operation we have never had any leakages and have had no trouble at all. The cost of this work is materially less than that of any other material now in use. The wood is made perfectly smooth before putting together, and the plan of construction is very simple, and valves can be used on any part of the pipe. Our pipe which is banded together with 5 × 8 ins. wrought-iron bands and is under 60 lbs. pressure, has not a leak in it—I think we have something to be proud of. The diameter of the pipe I speak of is 24 ins. We also have 30 ins. under 40 lbs. pressure. Our reservoir is situated on the highest hill in the city. One advantage is that a valve can be placed at any point on the line, and the cost is so small comparatively that we could afford to build 5 or 6 of these conduits in the way described cheaper than we could put in one regular cast-iron line.

A Member.—Do you ever have a break in your pipe? Can you shut off the water to make repairs as readily as you could a cast-iron main?

Mr. Holme.—Before the pipe had seasoned sufficiently we turned the water on; and the result was that a very little water oozed from the pipe—not enough to spurt, but just a little ooze. As soon as the pipe had swollen, we had no further trouble with it. We can build under water or in water, can build in 2 or 3 ft. of water, and we find no trouble in connecting this pipe with cast-iron pipe. We tested the pipe before we laid another; we tested it to 120 lbs. pressure per sq. in. The only question is one of durability. There is no question but that it will last for 25 or 30 years—we could afford to rebuild it half a dozen times (as I have said before) for what it would cost to put in one line of cast-iron pipe.

A Member.—We have a conduit which has brought water down from a high mountain which has been in use for 18 years and gives good satisfaction. If there is any question as to the durability of wooden pipe, I think our President can tell us as much about that as any one here.

President Fanning.—In constructing a system of water-works, in an Eastern city, I had to deliver water from the storage lake to the pumping station and to the turbines driving the pumps which were placed at a level 40 ft. lower than the lake, and distant more than a quarter of a mile from the lake. The water was conveyed from the dam at the outlet of the lake about 1,000 ft. in a canal to the brow of the slope at the foot of which stood the pump house. The water was to be taken down the slope to the pumps and to drive the turbines which actuated the pumping machinery. After consideration of several methods of construction of penstock for this purpose, a wood conduit was deemed advisable. The canal on the upper level was 10 ft. deep and the bottom of the conduit at the end of the canal was placed at the same level as the bottom of the canal, and the conduit then extended 700 ft. in length down the slope and connected with the turbines under a head of 40 ft. This conduit is 72 ins. clear diameter. It is constructed of southern pine staves. These staves are machine dressed on their edges to true radial lines, and in setting the machine cutters I tested by setting short pieces of staves on end on a floor, and adjusted the cutters until the staves placed in contact one after another would complete a true circle of 72 ins. diameter.

The trench to receive the conduit averaged about 10 ft. deep. The staves in the conduit were laid so as to break joints as a long mill floor is laid. Forms on which to lay the lower semi-circumference of the conduit were placed in the trench. Then starting at the lower end the staves were placed in position, the lowest staves being stretched up the slope farther than higher staves and when the semi-circumference at the lower end was complete its iron hoops were placed in position and the full circle of the conduit completed. Thus the laying progressed up the hill, the lowest staves being kept in advance, and the iron hoops being placed and tightened as the full circle advanced. This work was performed by laborers under supervision of a competent foreman.

The hoops were made of iron 2½ ins. wide, varying from ⅜ in. to ¼ in. in thickness, and each hoop had two tightening bolts at points opposite each other. The butting joints of the staves were made tight by introducing a thin plate of iron in each. Saw kerfs were cut tangentially, ¾ in. deep across each end of each stave, and pieces of hoop iron ¾ in. wide and ¼ in. longer than the width of the stave filled the kerf. The ends of the iron plates were sharpened so as to indent into the sides of each adjoining stave.

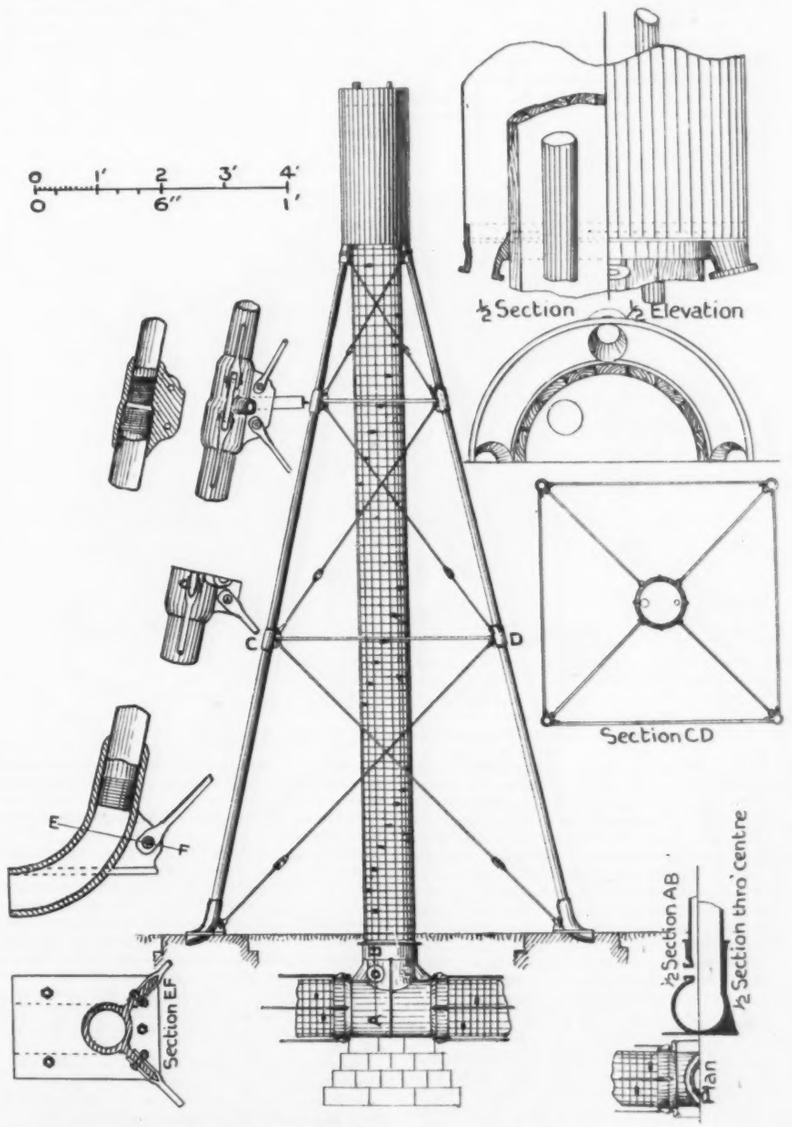
This 6 ft. wood conduit, under 40 ft. head pressure at its lower end has been in satisfactory use sixteen years, conveying water to the turbines and pumps and now gives promise of great durability.

One other instance I will mention, more intimately related to the subject of Mr. Babcock's paper. This is a vitrified pipe conduit under pressure. We built an impounding reservoir by raising a natural lake 14 ft., thus securing a reservoir of 180 acres area. The dam was 14 ft. high and the conduit leading water to the city was, in the gate chamber, placed at the level of the bottom of the dam. From thence it had a fall of 12 ins. per mile and extended 7,000 ft. toward the city, the remaining portion of the supply main being of iron.

At the lower end of the vitrified pipe was placed an open topped stand pipe rising to 3 ft. higher than the water in the lake reservoir. The use of the stand pipe was to lessen any shock of water ram that might possibly be reacted from the iron pipe back toward the reservoir.

This conduit is a Scotch clay vitrified pipe of 24 ins. diameter. Its joints are covered with wrought-iron sleeves packed with Portland cement. This conduit has been in use about twenty years under an average of reservoir pressure of 15 ft. head, with satisfactory results.

Mr. Johnson.—In improving the water supply of a town, in 1841, I ran across 2 wood mains of common size 6 ins. in diameter. These pipes were perfectly sound, except about 1 in. on the outside. I was told by some of the oldest inhabitants that they were laid 80 or 90 years ago and had been in use up to 20 years ago. They ran 1,000 ft. toward the mountain. These pipes as far as I could see were as ready to bring water as they ever were. Joints were butt or socket style.

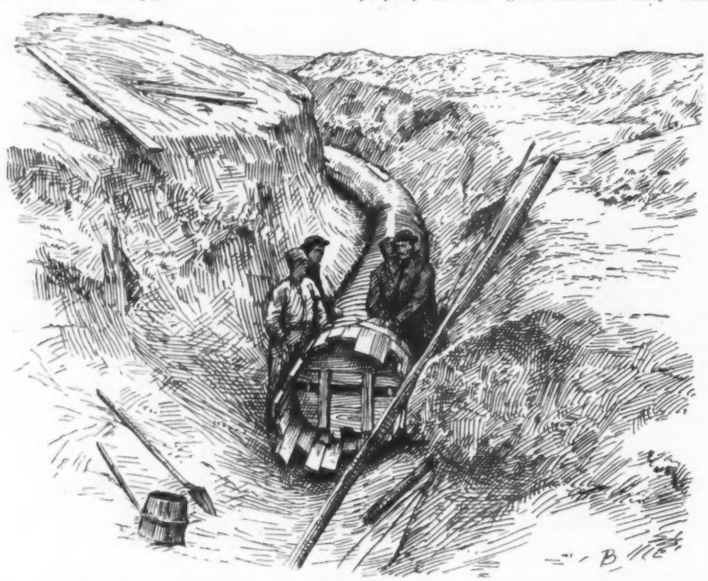


Details of California Redwood Stand-Pipe.—Chas. A. Allen, Denver, Col., Engineer.

A MEMBER.—We have pipe put in in 1860, under a pressure of 60 lbs., which is giving entire satisfaction.

PRESIDENT FANNING.—One of the conditions of the successful use of wooden pipes underground seems to be that the soil shall be constantly moist and one which is perfectly free from the circulation of air. In removing an old bridge from one of the New England streams we found that the sills on which the old pier or abutment originally rested, had evidently been laid in the ground at a low stage of the water. They were just on the water surface when we took them out. When they had been removed I took a chip from one of them which showed the wood to be in an almost perfect state of preservation, and now I have it as a curiosity. Upon investigation I found that the sills were put in about 100 years previously. The fibre was but slightly soiled, and was nearly as tough as that in new wood.

Mr. DARLING.—I would say, that circumstances may allow putting in wooden pipe, or one of the various other kinds of pipe which have been brought forward; but, I believe, that if you live anywhere near a foundry where they make pipe at a reasonable price, and of good quality, the most practical pipe that you can put into the ground is cast-iron pipe.



Laying California Redwood Water-Pipe. (See Discussion by Mr. HOLME, Jr.)

The next paper read was on "Consumption of Water by Cities and Towns," by Mr. N. W. AYRES of Hartford, Conn., after which a paper by Mr. Y. NAKAJIMI, of Tokio, Japan, on "Water Supply of Tokio, Japan," was read by title and referred to the Publication Committee. President FANNING remarked that there are doubtless many valuable points in the paper which has been so kindly sent from Japan, and those desiring to see it can do so directly after the meeting. The map accompanying it will be on the table in the next room. It is of such thin quality of paper, please be careful in handling it. There are also some very interesting drawings which were sent in connection with it, which are now on exhibition to those desiring to see them.

Mr. DARLING of Pawtucket, R. I., here made a very enthusiastic and impressive appeal to the Association on the importance of contributing blue prints in uniform size—of works executed or projected, at the next meeting and in response thereto a very large vote in favor of it was given. Mr. DARLING then eulogized the Association as the original society of its kind, and advocated close and discriminating sectionalism in other societies, deploring at the same time his inability to preserve such exclusiveness in the New England Society. He then extended a cordial invitation to the Members of the American Association to meet with the New England Society at Providence, R. I., in June. He was pleased to see the growth of this Association and hoped that it would continue to grow and eventually be the "Grand Lodge" of all the other Societies.

SECOND DAY. MORNING SESSION.

The meeting was called to order by the President at 10 A. M. An invitation to meet in the City Council Chambers and listen to a paper on the history of the Cleveland Water Works and a description of the same, by Mr. JOHN WHITELAW, President of the Civil Engineer's Club, and Superintendent of the Water Works, was accepted, and the hour of meeting fixed at 8 P. M., same day. Several matters relating to the business affairs of the Association were referred to the Executive Committee. A committee o nominations was appointed by the President: delinquents on payment of dues were ordered dropped from the list.

The first paper read was on "The Quindaro Settling Basins and Siphon Well", by R. C. PEARSONS, of Kansas City, and was read by the Secretary. It was an exhaustive description of a very interesting work, well illustrated by drawings. As we have already published a very complete description of this work, with drawings, in ENGINEERING NEWS we will refer our readers to the files of December, 1887.

Mr. DENHAM of Des Moines, Ia., presented the first voluntary paper. It was in reference to a decision by Judge GILL, upon the rights of Plumbers vs. Water-Works Company. The trouble related in this paper arose in Kansas City between Messrs. SHIRE BROS., and the Water Co., on account of their refusing to obey part of an ordinance which had been passed, giving the water company rights to which they claimed they were not entitled. Mr. DENHAM said that the city had no doubt given the company unusual power, as it had passed an ordinance declaring that no plumber should tap a main without permission from the Water Co.; and give a bond for $500 with satisfactory security, that they would perform the work properly and use good material. They were also to report to the Company within 24 hours. For each violation a fine of not more than $10 and not less than $3 was to be imposed.

The article was headed "No Permit Needed. Judge GILL's Decision in the Water Work's Case."

In effect the article said that the Judge had decided that it was not necessary for a plumber to get a permit, give bond, etc. The heading, Mr. DENMAN said, was somewhat misleading. Judge GILL does not decide any such thing—he simply does not forbid a person tapping the mains.

I think this will be of interest to some of us, (though perhaps not to all) especially to those who come in contact with plumbers daily as it is the first time the question of plumber's rights in connection with water companies has been tested; and I shall watch the outcome with much interest. I present it because I believe it to be of general interest.

The parties prominent in this case at Kansas City were Messrs. SHIRE BROS. They had taken out a license, given bond as required, etc., but refused to ask for permits for every tap or connection they should make. The question arises whether they were right in making this refusal or not. As to what is reasonable in such cases it largely depends on the circumstances in the particular instance where extensions are to be made. We cannot of course condemn these rules and regulations, unless they openly defy what is right. I do not think it is unreasonable for a water company to require that plumbers shall get a permit to make connections to a water main before turning on the water. I have sent this article to one of our local attorneys, and also to one of higher authority, and they both agree that the plumber should get a permit before turning on the water. That is all very well as far as it goes, but suppose they do turn the water on after making a connection and make no report to the water company.

As an illustration of this fact, to show how it would injure a company if they did do this Mr. DENMAN said, that a pipe could be extended into the next room of a house, a bathroom for instance, and a large amount of water be used, and the company never know anything about it. Or it could even be extended to a neighbor's house.

After a general discussion of the matter in which the opinions were about equally divided for and against, Mr. DENMAN said, that while it was necessary for water companies to be protected and have certain rights, he did not know but they had gone too far with the question of rights in this particular instance. But suppose a plumber does disregard your rules and regulations? He makes the connection without your permit? What are you to do? Our only remedy in such cases is the "common law", and if we go to a lawyer to get damages, the first thing we have to do is to pay him $10 to $50 for his services. And what does our claim amount to? $5 or $6 possibly. Not much satisfaction in that. The position of the judge is this, the rules adopted by the company are unreasonable. It is questionable whether a plumber can be *required* to give either a bond or to ask for a permit. If water companies could be placed upon the same basis as commercial men, as for instance the grocer or the merchant, to whom we have to go and buy whatever we want by weight or measure, it would be looked upon in a different light. The general opinion, however, is that a bond or permit cannot be required, and after considering all sides of the question, I am inclined to think that the requirements of the company were too rigid. I think water companies would be more successful by serving injunctions on owners of property rather than on the plumber, who really is but the owner's agent.

Mr. TUBBS, of Rochester said: It seems to me that a plumber should not be allowed to tap mains without a permit from the company. Such work should always be done by the company, and I think plumbers should be required to obey any fair and reasonable rules and regulations for the protection of the water company.

Mr. DENMAN said they had no trouble in controlling the tapping as they had one reliable man who did all of it. In reference to extensions he said, that many people would get work done by a plumber, and never tell anyone that it had been done. One of our inspectors upon calling at a house and finding that additions had been made, whereby a large amount of extra water was being used, inquired who did the work and when it was done. In reply to his question, he could get no satisfaction as to who had done the work. The only reply being, I did not ask the man his name, he did the work, and when it was done I paid, that is all I know about it.

An invitation from Mr. BURKE of the Lake Shore Foundry, to take a drive on Friday morning to the Fairmount Pumping Station, to the works of the Lake Shore Foundry and witness the method of casting water pipe, and to other places of interest, was accepted.

Mr. SAMUEL MCELROY's paper on "Reservoirs" was read by title only, Mr. MCELROY not being present.

On motion of the President the remainder of the session was devoted to the subject of "QUESTIONS and ANSWERS."

Question (1).—"What reason, based on just treatment of the public at large, is there for making a less rate for manufacturing and elevator purposes than for culinary purposes?

A MEMBER—"I do not know how private corporations figure this out, but representing a city, I would say that we base these matters on the ground that we can pump 1,000,000 galls. cheaper than we can 10,000 galls., and as such concerns call in use a large amount of water, we make them lower rates, on the same principle that you can buy a car load of goods cheaper than you can a small quantity.

Mr. DENMAN stated that in some cities he believed that where water was furnished for a specific purpose, it was furnished cheaper than for general purposes.

Mr. RICHARDS stated that they charged one price for all. We claim that the man who uses more water than a small consumer is just in the proportion to the amount of water used, more able to pay for it. We make no discrimination. I do not see why this rule would not apply with private companies as well as with cities.

Mr. TUBBS expressed the opinion that water-works were constructed especially for domestic purposes and the preservation of health, and that if there was to be any discrimination made he believed that the household consumer should have the benefit of it. In regard to the meter rates in Rochester, N. Y., Mr. TUBBS said, there were several parties who would like to have their rates reduced, but that he doubted very much whether they would succeed under the present management.

The SECRETARY stated that the question referred particularly to cases where equal amounts of water were used. "I am opposed to making any difference in the rate where the same amount of water is used, and do not think it is right to make a difference of 25 per cent. in rates between the use of water for elevators and for services, where it is carried to the same point at the expense, as for instance a line of pipe conveying water to an elevator, and another one to a point equal in distance, where actual cost is the same. I have known of such cases."

Mr. DECKER in making comparison of prices as charged by parties whom he knew, gave the following figures, for places where the same amount of water was used and produced at the same expense:

For elevator use.....	$50.00
" service "	74.00

A difference of $24.00 for the same amount of water and an equal length of time.

Mr. TROY stated that it made no difference what business their consumers were in, nor to what use the water was put, their rate being based on a sliding scale.

Question (2) with reference to charging for the amount of power used was brought up, and it was generally conceded that a man should charge for the power used in producing, but not for the water if there was to be any discrimination made. Mr. FANNING thought this would be a very fair way to discriminate, if there was to be any discrimination at all. Opinions were expressed freely in regard to this question, but it was generally conceded that no discrimination should be made.

Question (3).—Where water is sold by meter has the consumer any right to sell to his neighbor?

The opening argument was not in favor of it, and the opinion was expressed that a man had no right to do it; but Mr. DENMAN'S query "If a man pays for a thing does he not own it, and cannot he do with it as he has a mind to?" seemed to turn the tide of opinion in the contrary direction.

Mr. RICHARDS thought that it would be allowable for two parties to use from the same meter and each pay a uniform rate. The matter of prices for water throughout the country as measured by meters, seems to vary greatly in different parts of the country, and scarcely two places supply water on the same terms. This fact has been clearly shown by the discussion this morning—as we have been told that one company will charge everybody the same price, whether it is used for service use or not, not charging for extra pressure, another will charge 25 per cent. more for domestic use than for elevator and manufacturing purposes, another has adopted the sliding scale and so on—when we look into the question we find a great variation in the different places.

Mr. GERECKE said that the Common Council had refused to have meters introduced into Chicago, fearing that the rates would be made too high. But he was glad to find them in such general use in the East.

The question of a man's having a right to sell water where another company had the franchise was discussed, but it was generally agreed that he had.

The last question of the Secretary was: "In case of a contract to furnish water for a specified sum per annum—the amount of water to be used being defined in such case—has the customer the right to sell or dispose of the unused balance?"

No more pertinent reply, perhaps was given to this than Mr. DENMAN'S previous remark in reference to a person's right to dispose of what he had bought and paid for in whatever manner he saw fit.

Mr. GERECKE, the new Superintendent of the Chicago Water Department, made a few remarks on the recen discoveries of incapacity in the Water Department of that city and the trouble with the engines, which have been already referred to in these pages, and which have become a matter of public notoriety. As to the report about the impurity of Chicago water, he said it was a malicious and untrue story started by a discharged employé.

The meeting then adjourned.

WEDNESDAY AFTERNOON SESSION.

Meeting called to order at 2.35 P. M. The Executive Committee reported that in relation to the matter referred to the Executive Committee this morning with regard to non-members exhibiting their goods at our Conventions, it has been resolved that no one except members of the Association shall hereafter be allowed make such exhibits. They must be Associate Members. Carried.

The following paper by H. F. DUNHAM was then read:

"ONE PHASE OF THE PROBLEM."

To members of this Association there is little need to define or describe those bad water localities which have taxed the ingenuity of engineers. You all know where they are, and the difficulties they present are increasing in a ratio greatly out of proportion to the increase in population. Only a few years ago the engineer was comparatively alone in his work; now a whole army of physicians, chemists, and microscopists are driving him to the wall with facts and theories that cannot be disputed. We can no longer find comfort in thinking that, after all, it may not be so bad; for recent discovery throws backward its light upon the statistics of older communities, and shows us there the results of methods like those upon which we now rely. Water, not as rivers furnish it—which in many places is bad enough—but as man has polluted it, is being supplied through pipes, as it has been for hundreds of years, "for all purposes". We should not overlook the attempt at purification, and great credit is due to inventors and all those who have helped to awaken interest in the subject. But to purify the water for a great city is a very difficult matter.

But all this about abundance and scarcity is mere commonplace and unworthy of your attention, except as it is aimed at a popular error which leads to dreadful results. There is no need to remind you that we all look to the people for support and assistance in these important questions of method and expenditure. Their opinions and actions are essential to every undertaking. Now, in this interval of a few years, during which so much has been discovered that calls for prompt and decided effort, people have been led into a position where such effort becomes difficult. It is true, the impression that water is free and not a saleable article has been largely removed, but in its place we have the no less dangerous notion that in all places a certain definite sum of money should pay for a certain definite quantity of some kind of water.

Men of liberal education have pointed with conscious pride to the low rates in their cities when those rates should have been looked upon as a disgrace. Councilmen and others with the interest of the people at heart have assumed, in establishing rates, that unless the rate was as low as in some neighboring city—where the conditions were entirely different—people would be driven away from their town or not attracted by it, and to-day such notions are common.

They are all wrong. We might as well stop the transportation of grain and then by means of adulteration make the price of flour uniform all over the country, the same in New York and Minnesota. You might as well say that because foundations for building in Detroit cost upon the average only $5 per sq. yd. we can pay no more than that in our city, regardless of what the excavation shows. If all the cities had adopted that course, the architecture of the country could hardly have been in worse condition than the drinking water of the country is now when compared with what it ought to be. Wholesome water should be made the one and only basis, and the rate charged should be determined by the cost of procuring it, and there is no city in our country where people cannot afford to pay that rate better than they can afford to pay any rate for unwholesome water.

Where the issue is plain and in no way obscure there is less to criticise. We have an illustration in our midst. Six thousand families in Cleveland are using well water where wholesome water is convenient. But how was it found out that there were 6,000? Why is the fact published and known all over the country and wherever English or German papers are read? Why are steps being taken to make that number less? It is simply because the intelligence of the present is demanding that after the best has been provided it shall be accepted in order to preserve health. To demand that the best possible shall be provided for the same purpose is no less a duty.

In some remarks supplementing his paper Mr. DUNHAM said the time might be near when water could be profitably distilled and delivered through independent but small pipes in some of our cities. The quantity would be limited to that required for drinking and cooking. This led to a discussion of the healthfulness of distilled water. Pres. FANNING said such water could be easily brought to any required degree of hardness.

F. S. FULLER, of Ware, Mass., read a paper on "The Indirect Income of Water Supplies", and B. F. STEVENS, of Flatbush, N. Y., read a paper on "Stand-Pipes for Water-Works." This was a very interesting paper. The writer had collected a large amount of statistics in relation to his subject and in the paper has presented them. There are 282 stand-pipes in the United States. A list of failures and their causes were recited, and particular reference was made to the Gravesend Water Tower, of which Mr. STEPHENS was the contractor. The bursting of the tower was described and the entire blame was laid upon the iron, some defective plates having been introduced, other than those of SHOENBERGER'S, of Pittsburg. The discussion only brought out the statement that the water tower at Sandusky, O., was second in size in the United States, that at Houston, Texas, 225 ft. high, being entitled to first place. This entire paper we will publish hereafter; a simple abstract will not do it justice.

WEDNESDAY EVENING, 8 O'CLOCK.

By invitation of the Cleveland Civil Engineers' Club, the Association met at the City Hall, where a paper on the Cleveland Water-Works was read by JOHN WHITELAW, President of the Civil Engineer's Club, and Chief Engineer and Superintendent of the works since 1867. An account of the early history of the works was given in ENGINEERING NEWS of April 23, 1881, and we condense very briefly this portion of the paper. The first works were completed in 1856, under direction of THEODORE R. SCOWDEN, C. E., and consisted of a pumping plant of two Cornish engines of a total capacity of 7,500,000 galls. per day, with a 6,000,000 gall. storage reservoir. The cost of these works was $526,713.

In 1866 there were 13 miles of distributing mains, 130 stop gates, and 44 hydrants. On Jan. 1, 1888, there were 251¾ miles of mains, 5,000 stop gates, and 2,517 fire hydrants.

The water near the inlet pipe, 300 ft. from the shore, became polluted, and the tunnel beneath the lake was started in 1869 and completed in 1874. It is three-quarters of a mile in length and 5 ft. diameter. A new pumping engine of 10,000,000 galls. capacity was added in 1874 and two years later another of the same capacity was added, making the total capacity in 1876, twenty years from the completion of the works, more than three times as great as was originally supposed would be ample for the needs of fifty years to come. Other pumps were added in 1882 and 1884 and still others are now being erected, to be completed in July, when the total daily pumping capacity of the works will be 70,000,000 galls.

For supplying that part of the city west of the river one 33-in. and two 36-in. pipes have been laid. They are ⅝-in thick and of double riveted wrought-iron. They are 220 to 270 ft. long and dip by very easy curves to a point about 25 ft. below the water surface. Trenches were dredged for the pipe before they were laid.

Land was purchased in 1882 for a new storage reservoir and for a high service pumping station and reservoir. The former, known as the Fairmount reservoir, consists of two basins, one of about ten acres area and 47,000,000 galls. capacity, the other of 33,000,000 galls. capacity. The high service reservoir is of 38,000,000 galls. capacity. Water is pumped to it by the old Cornish engines from the Fairmount reservoir through a 30-in. main, 13,000 ft. long.

There are now about 25,000 service connections and 1,525 meters, which averaged per day last year a measurement of 5,500,000 galls. The average daily pumpage in 1887 was 22,250,000 galls., but in July the average exceeded this, reaching nearly 32,000,000 galls.

A contract was awarded on March 24, 1888, for boring an additional tunnel from the lower pumping station out 9,200 ft. into the lake. The tunnel is to be 7 ft. in diameter and is calculated to deliver 110,000,000 galls. per day with a suction of 13½ ft. In computing the delivery, allowance was made for the inequality of the surface of the masonry and for the angles at the shafts. The total capacity of the two tunnels will be about 150,000,000 galls. per day.

In the discussion which followed much matter of interest was brought out. The total annual revenue is now about $400,000. The increase in population which has made necessary the rapid extension of the water supply was tabulated as follows:

Year.	Population.
1796	4
1830	1,075
1840	10,135
1850	17,034
1860	43,838
1870	92,825
1880	106,140
1888	214,013

The average consumption per day per capita is now a little over 90 galls.

Some experiments were made last fall on the comparative economy of crude petroleum and coal. The test was of 54 hours duration and 22,500,000 galls. were pumped.

Cost by use of coal (at about $1.55 per ton) including labor	$64.22
Cost by use of oil (6,131 galls. at 1¼¢) including labor	81.59
Difference in favor of coal	17.37

The total cost of plant to date is about $5,500,000.

A description was given of the difficulties encountered in driving the lake tunnel. The soil is similar to that found at Chicago. The greatest source of trouble was a fault in the rock strata which let in quicksand. A bulkhead was built and the tunnel was curved around the bad ground. This had to be done two or three times. Near the inlet shaft a very soft clay was encountered and a shell was built similar to the one used at Chicago. The tunnel at the shore is 78 ft. below the level of the water. At the inlet shaft the water is 38 ft. deep. In driving the tunnel indications of the channel of an ancient stream far below the present bed of the lake were encountered.

The inlet crib was 64 ft. high and the clay of the bottom was so soft that the crib was sunk 13 ft. into the mud by loading it with stone. A thousand tons of stone were put into the crib in addition to the amount in the crib when it was towed out.

Mr. WHITELAW answered a question in reference to anchor ice, saying they had never been troubled with it. An accumulation of snow two years ago interfered with the supply for two days.

The cost of the first tunnel was given at $330,000. The new tunnel is to be about 30 ft. from the old.

No sewage contamination has ever been found in the water except when the lake is frozen over. The water west of the river outlet is generally much less contaminated than that east of the river. Samples of water from various portions of the lake, some taken 4 miles out from the shore are now being analyzed and the results will appear in Mr. WHITELAW'S report soon to be issued.

(*Continued on page 346.*)

Mr. JOHN C. TRAUTWINE, Jr., writes us: "For the benefit of such of your readers as may have occasion to use Barlow's Tables (London, 1814), I beg to note a couple of errors upon which I happened to stumble, viz.: The cubes of 5,749 and 5,750 are given as 180 etc., and should be 190 etc."

ONE would naturally suppose that after a bridge had been threatened a number of times by freshets the owners of the structure would raise its piers and abutments and lift it above any contingencies of flood. But they do not. They tremble with fear, exult with gladness, and then forget that they have either feared or exulted over the varying situation of the bridge.—*Milwaukee Wisconsin.*

The Adopted Plans for the Brooklyn Bridge Terminals.

We present herewith in three engravings (1) the plan submitted by Mr. C. C. MARTIN, Chief Engineer and Superintendent, to the Board of Experts and rejected by them; (2) the planfor the New York terminus prepared by Mr. MARTIN since the decision of the Board of Experts was rendered, and adopted without discussion at the last session of the Board of Trustees; (3) a similar plan prepared and adopted in a similar way for the Brooklyn terminus. We owe the opportunity to present the last two to the courtesy of Mr. MARTIN, who sent the plans to Mr. WELLINGTON in person, with his compliments. The opportunity to present the first we owe to the courtesy of a member of the Board of Experts.

To what extent, and in what degree the two plans differ from each other we leave to the judgment of our readers. Seven different plans of the "tail-switching" type were under the consideration of the Board of Experts and all were rejected, not individually, for defects special to each, but by a general condemnation of the type as a type, as may be seen by referring to the report of the Board of Experts published in our issue of March 17. How strong the probability is that, had the plans just adopted made an eighth in the list of "tail-switching" plans, and been likewise studied by the Experts, they would have reconsidered their condemnation of the type, and recommended this particular embodiment of it, we cannot undertake to surmise.

The routine of operation under the adopted plan is as follows: The approaching trains drop the cable some distance back of the station, and acquire an accelerated velocity sufficient to carry them by their own momentum to the platforms. While the passengers are discharging, a switch engine hitches on and pulls the train back to the end of the track. This operation takes from 29 to 36 seconds with 3-car trains, for a distance moved of some 360 ft.; an average velocity of 10 ft. per second, and a maximum of some 20 ft. per second. The addition of another 50 ft. car will consequently increase the time for this operation some 5 seconds, to 34 to 41 seconds.

The return trip is made by the cars in the same time. The switch is thrown over behind the cars as soon as it clears and the engine makes a flying switch, stopping just before it reaches the facing point switch to have it again thrown over, and then backs down to couple on to the next train, which in the meantime has discharged and is ready to pull out. The maximum time during which the engine is actually in motion is thus: 41 + 41 + some 5 seconds delay to throw the switch, making 87 seconds; trains from each of the double platforms being under this new plan, run 80 seconds apart.

The switching is done over 100 ft. radius reversed curves (56°). The switches are not and cannot be interlocked—it is too quick work—but are thrown by hand.

Every train, which it is proposed to run at 40 second intervals, passes over the crossing on the 56° reversed curves. The crossing is therefore actually occupied by trains or threatened by a moving train a few feet off—calling the duplicate platforms *A* and *B*:

By train *A*, 41 less some 5 seconds; say	36 secs.
By engine of *B*, backing down,	11 "
By train *B*, same as *A*,	36 "
Total, for every pair of trains,	83 secs.

This gives 83 seconds out of every 80 during which the crossing is either occupied by a train or threatened by one in motion a few feet off.

In these computations we neglect altogether certain difficulties as to how the trains are to be started, for lack of definite information, which must at best still farther complicate the matter.

We are growing a little tired of pointing out in detail the nature of the successive follies of the powers that be on the Brooklyn bridge. This makes the sixteenth plan,all told,which has emanated from that source within six months, although only one of them has heretofore seen the light of day in printer's ink. In that case all that we said about it was confirmed to the letter by as competent and disinterested a Board of Experts as can be found in America. In the immortal words of the mythical Mrs. HARRIS another one is "one too many if not nine". We will therefore say now merely that,—for reasons which will be sufficiently apparent to those who are in any sense experts in such matters, and which those who are not experts will not feel concerned with, nor possibly be able to understand if we took several pages to point them out in:

1. The adopted plan cannot be operated for ten minutes in safety, with trains ten minutes apart.

2. It is a physical impossibility to run trains on the proposed 40 second headway, for other reasons.

3. It is practically impossible to realize appreciably more capacity by the double system than by the single system, for still other reasons, so that the table of alleged additional capacity is almost wholly fictitious, the only appreciable increase being in the operating dangers.

4. It involves operating difficulties and dangers which no man in his sober senses who realized what he was doing would dream of incurring for six months, even if there were not the aforesaid difficulties in keeping in operation for a day or an hour.

To the above list may be added certain minor points, which yet seem worthy of some attention:

1. Connection with the elevated railway is done away with, except by overhead bridges over the track, with two new flights of steps.

2. The bridge over Chatham Square now used by practically all passengers from the City Hall Park sidewalk becomes useless for the same reason. Hence, all the people who now use it must all cross Chatham Square on foot and join the rest of the throng. In other words, whereas 12,000 people per hour are now using two distinct modes of approach to the trains in about equal numbers,45,260 (less such as may enter from William and Rose Sts., if stairways not shown are provided) are to use only one mode of approach of the same dimensions as now.

3. No provision is made for the promenade. The tracks must be raised 8 or 10 ft. higher than their present level to permit it to pass underneath.

4. The station is moved further back from the street by the amount shown in the engravings, the center of the platform being 377 ft. from Chatham St., against only 100 ft. in the plan recommended by the experts.

5. A derailment on the crossing throws a train moving at 14 miles an hour against the corner of the outgoing platform, where there might be several people standing, and cause a panic, especially as—

6. The platforms in a practical sense are no larger than now for the present traffic, there being trains on both sides of them.

7. The present excessive crowding of 100 passengers per car,assumed as the maximum in all projects before the experts, is increased to 126 per car, only one-third of them seated, in order to show more capacity.

8. The heretofore accepted interval of 90 seconds between trains, announced as the safe minimum as a guide to the experts, is reduced to 80 seconds, in order to show more capacity. These two differences alone reduce the proper comparative capacity from 22,680 and 45,360 to 16,000 and 32,000 per hour, even if either could be otherwise realized.

So we might go on for some time more, but this is enough.

As we have never heretofore even alluded to the matter in these columns, it may be well to satisfy a natural curiosity as to how the adopted plan originated.

It is a modification of a plan which has been under consideration by the Board of Trustees independently of and coincidently with the deliberations of the Board of Experts, known heretofore as the "Barnes plan", from the name of the trustee who brought it forward, but which is now claimed as his own by Mr. MARTIN, as it was understood to be from the beginning. How the unusual situation came about that one man could have two plans under simultaneous consideration, one before a body of Experts who were considering sixteen others at the same time, and one before a body of non-experts, who were considering no other, may be thus briefly summarized:

The criticisms published by this journal June 4, and 11 last, and republished by the Brooklyn *Eagle* of the same dates, of some former (and much better and more defensible) plans which had been adopted with equal haste by the same body, on the recommendation of the same terminal committee (THOS. C. CLARKE, CHAS. MACDONALD and JAMES HOWELL, *ex officio*) compelled withdrawal of that adoption and the appointment of a Board of Experts, nominally to consider the whole matter. The study due to the preparation of those criticisms led Mr. A. M. WELLINGTON, of this journal, to form certain plans of his own, which were publicly and repeatedly stated to be for 14 car trains. The first letter of instructions to the Board of Experts expressly and in terms restricted the Experts' studies to plans for not over 6-car trains, thus wholly excluding Mr. WELLINGTON's plans from consideration. After some vigorous protests by the Brooklyn press this first letter of instructions was withdrawn and a new one substituted, removing the first restriction but substituting a new one, that the experts were to consider only *plans for the New York terminus*.

The Board of Experts then began their studies of the proper form for their half of the bridge pair of shears and almost simultaneously a certain "Barnes plan" for the other half began to be vigorously pushed before the Board of Trustees. A second and independent Terminal Committee of the Trustees was appointed which reported in its favor, and it was on the very point of being adopted for the Brooklyn terminus by the full Board when the report of the Board of Experts appeared, (Feb. 23), with its radically different recommendations, and temporarily killed the plan. It had enough vitality, however, to cause the Chief Engineer to be instructed to prepare estimates on "both" plans, viz.: that which had been recommended and that which had not even been considered, and so had not been rejected.

The estimates on both plans were made by the author of the latter, and he found one of them to be very economical indeed ($773,000) while he found the other one to be very expensive ($5,773,250). The formality of laying before Mr. WELLINGTON, the figures for his own plan at least, to see if there was not some mistake about them, was omitted, although it might have been seen from the following editorial note, which appeared in our issue of April 14, three days before the late Trustees' meeting, that Mr. WELLINGTON held radically different views as to cost:

> "At the regular monthly meeting of the Brooklyn Bridge Trustees on April 9 * * * the papers and estimates of cost were not ready for transmission, so that in the meantime there is still opportunity for 'the opposition' to the recommended plans—which so far as yet appears is confined to Mr. PULITZER, of the *World*—to continue to publish absurd exaggerations of probable cost, which the *World* has worked up to five, six or even ten millions, while $2,000,000 is actually an outside sum. The French's Hotel lot is certainly a most admirable one for a newspaper building, but the fear of its loss would hardly lead a journal of any character or responsibility to the extreme which the *World* has adopted."

We did the *World* injustice. What we supposed to be merely its wild exaggerations, and so spoke of with contempt, was really inside information.

Mr. WELLINGTON's prompt response, when he had opportunity to know as much as the *World* did about official views, appeared in our last issue. He alleged the estimates to be exaggerated:

1. By a gross sum of $3,889,290, including one item of $443,000 without a shadow of foundation.

2. By suppressing all reference to a smaller and cheaper plan for shorter trains, which Mr. WELLINGTON had only enlarged at the request of the Experts, (and they only in accordance with instructions written by Mr. CLARKE to seek first the largest possible capacity,) and which, we may now add, it had been his purpose to alone describe, despite the action of the Experts, until Mr. THOS. C. CLARKE advised him in writing to describe only the larger plan, which Mr. CLARKE had also endorsed in writing, both of these communications being now in Mr. WELLINGTON's possession, and the first dated only a few days before he signed the report condemning the plan on the ground of cost and length of trains.

3. By suppressing all reference to the fact that about half the capacity of the smaller plan would equal the alleged capacity of the plan adopted.

4. By suppressing all reference to operating economies which pay interest at 3 per cent. on $4,280,000

The secret purposes which underlie such determined fighting for bad plans as to lead to such monstrous extremes as this, we do not know. That a decisive majority of the Trustees and the public

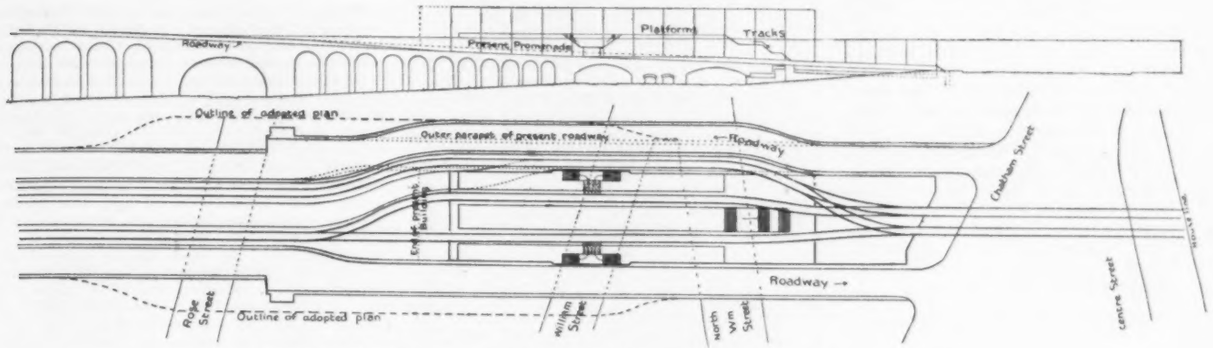


FIG 1. Plan for New York Terminal Submitted to Board of Experts and Rejected by Them.

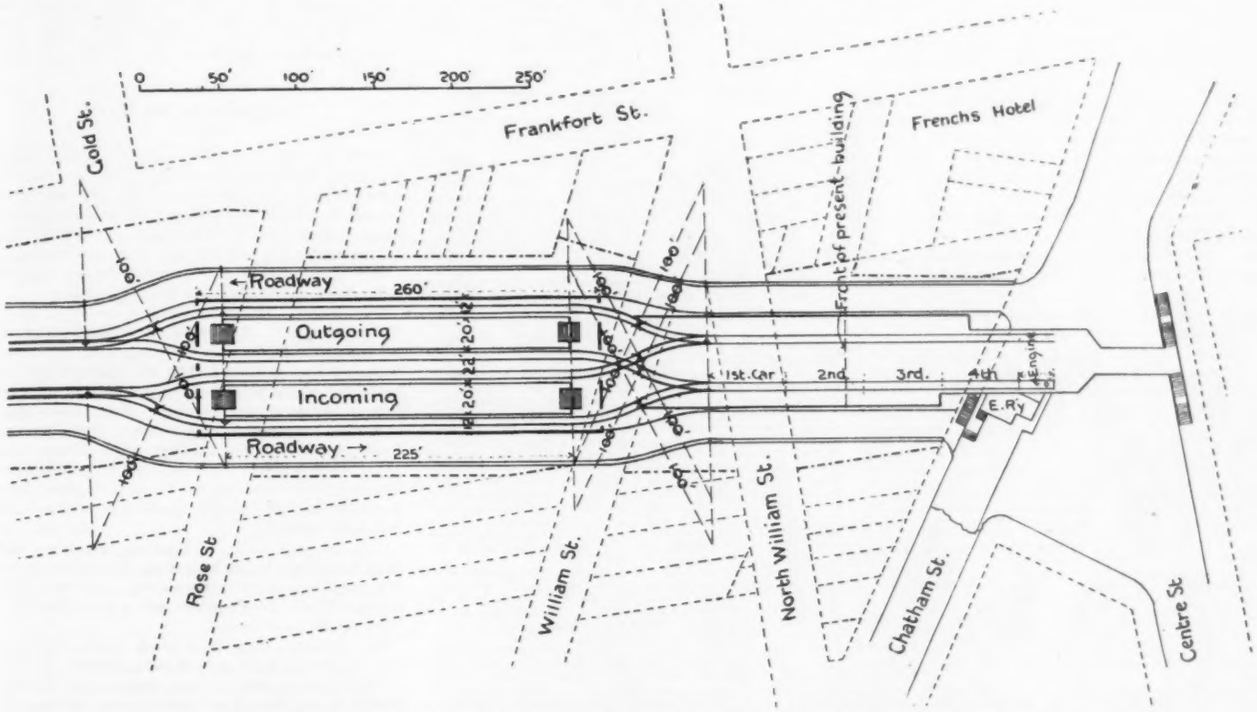


FIG. 2. Plan for New York Terminal Adopted by Board of Trustees on Recommendation of Terminal Committee.

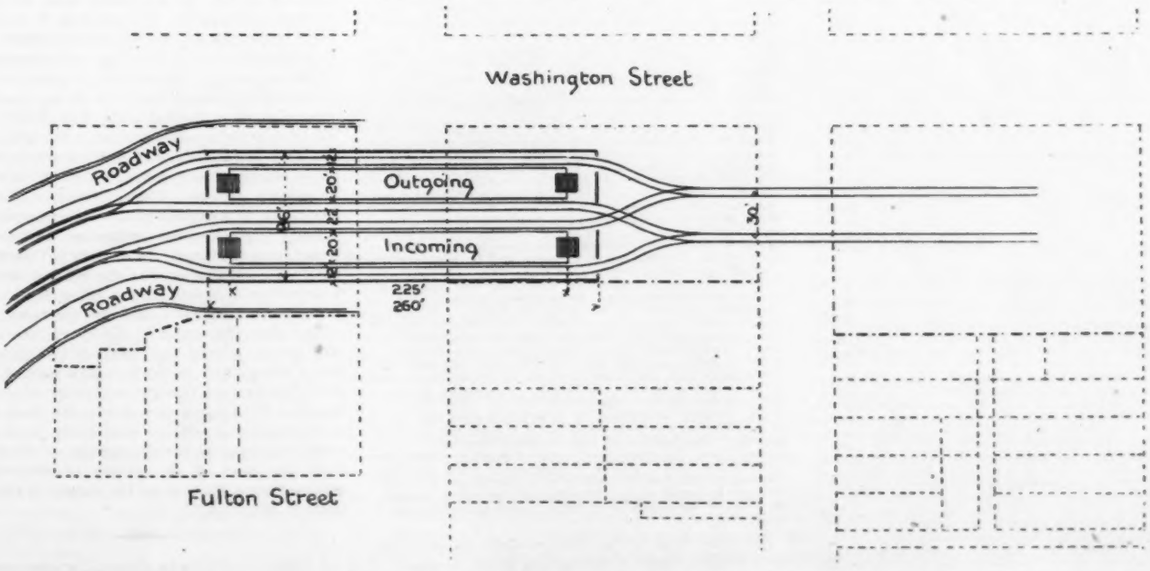


FIG. 3. Plan for Brooklyn Terminal Adopted by Board of Trustees.

PLANS FOR ENLARGED TERMINAL FACILITIES FOR THE NEW YORK AND BROOKLYN BRIDGE.

C. C. MARTIN, Chief Engineer and Superintendent, Engineer.

mean to do the right thing, and have been merely misled, we firmly believe. Whether there be some big contract for another bridge looming up in the future which too much capacity of this bridge might postpone; whether the real estate interests of certain of the trustees (which have been described in detail in the public press) make them determined to have some plan like the MARTIN-BARNES, which leaves the road to an extension to the City Hall always open, rather than one which permanently closes it; or whether it is merely the sentiment which the dragon in *Siegfred* roars out through his fog-horn; "I am in possession; let me sleep on"; these are questions which we do not even take the trouble to ask, much less to answer. Whatever the motive, there can be but one opinion of the actions themselves, and should be but one result possible.

The Brooklyn Eagle on the Bridge Question.

The following editorial appeared in the Brooklyn *Eagle* of Saturday last in reference to the late action had on the strength of a report by the Terminal Committee. As most of our readers know, the Brooklyn *Eagle* in a peculiar sense is Brooklyn, as no other one paper in any other city of great size can be said to be. It has become such by its fearless independence in taking decided stand in just such matters as these, where the public interest is involved, which it has done a dozen times before, and its position alone assures that there will be a thorough ventilation of the late proceedings and a consequent complete defeat of the late attempt to settle the question by secret machinations, based to all appearance on anything but creditable motives, in defiance of the carefully matured conclusions of experts, which latter one of the Terminal Committee of two, and the only engineer member, endorsed in writing in the most unqualified terms after their announcement.

PRESIDENT HOWELL AND ENGINEER WELLINGTON.

The *Eagle* on Friday published an open letter from Mr. A. M. WELLINGTON, the eminent civil engineer, to Mr. JAMES HOWELL, president of the Board of Bridge Trustees. In the same issue were published interviews with Chief Engineer MARTIN and President HOWELL, of the bridge, in reference to that letter. Mr. MARTIN'S words were simply to the effect that he thought he should be credited with knowing something about the question, because of his position; that he did not propose to engage in newspaper controversies, and that he thought the action taken by the Board of Trustees at the last meeting would prove to be a wise one. President HOWELL declared that he had read only the first paragraph in MR. WELLINGTON'S letter; that he did not know whether he would read any more or not; that regarding the charge of having suppressed and misrepresented statements in Mr. WELLINGTON'S plan he thought life too short for such a discussion; that he, too, did not intend to engage in newspaper controversies; that he also thought the action of the Board would prove to be a wise one—and that he was of the opinion that Mr. WELLINGTON should in courtesy have sent the letter to him before he gave it to the press. [Which Mr. WELLINGTON did do. ED.]

These rejoinders are as much alike as two pieces of thread of equal length off of the same spool. If the men had been in conference to agree on what they would avoid saying—while appearing to say something—they could not have hit on a closer likeness of statement. The *Eagle* is of the opinion that they will yet condescend or be constrained to give more attention to Mr. WELLINGTON'S letter, for nothing is plainer than that, whether Mr. HOWELL or Mr. MARTIN declines to engage in a controversy with Mr. WELLINGTON in the newspapers or not, neither will be able to avoid a serious controversy with the Board of Trustees on the extent to which the serious allegations in Mr. WELLINGTON'S letter are correct or incorrect. The letter cannot be ignored. It will have to be met. If proved, a reconsideration of the subject will have to be taken by the present Board or their successors. If disproved, the facts which disprove it will have to be exhibited by the Trustees to the public, who in doing so will thereby meet the necessity which the letter creates for them to show, (1) that Messrs. HOWELL, MARTIN and CLARK have not misled the Board, (2) that they, with Messrs. HOWELL, MARTIN and CLARK (the committee on the matter) have not misled the press and the public. Just now the Committee and the Trustees may not think they will have to do this. What they think just now is not so important as what they will have to think after not a long while, and that can be much more readily foreseen by the press than by them, because it is one of the frequent duties of the press to render official boards and their agents amenable to reason and respectful to public opinion. The task will be accomplished in this instance, all the more certainly if the committee of the Board at present think it will not be.

The *Eagle* accepted the estimates of the committee concerning the construction and operating expense of the WELLINGTON plan as true. So accepting them the *Eagle* regarded $5,777 250 as too large a sum to pay for the plan as it is perhaps a little less than half what a new bridge could, with the light thrown by the history of the present one, be built for. On that account, we preferred the substitute plan adopted by the Board at the request of its committee as the more reasonable, even if it did not equal in scientific respects or in assured carrying capacity the WELLINGTON plan. The taxpayers of Brooklyn were of the same opinion—the figures of the committee being regarded as true.

Are those figures true? Mr. WELLINGTON says they are not. He is careful to particularize this statement. He deals item by item and estimate by estimate with the report of the committee, and the allegations which he makes are of a startling nature. The brief but luminous letter of his in last night's *Eagle* has undoubtedly been read by as many of the people of Brooklyn as will control and compel the eventual decision of the matter. That letter is an indictment to which the committee will be required by the trustees and the trustees by the public to plead. There will be no getting away from meeting and refuting that letter, because no confidence can be placed in the action which the Board did take, until it can be shown, and unless it be shown, that, in the action which the Board refused to take, truth and good faith were observed. Not one inch of progress in the BARNES-MARTIN plan can be made and not a cent's expenditure on that plan can be made, until the impeachment which Mr. WELLINGTON'S letter presents of the whole proceeding be overturned. President HOWELL and Engineer MARTIN should not labor under the delusion that the WELLINGTON plan is primarily involved in this matter. The BARNES-MARTIN plan is the one involved. If the figures in the WELLINGTON plan were overstated the presumption is that the figures of the BARNES-MARTIN plan were understated. If confidence cannot be placed in the committee's representations against the WELLINGTON plan, trust is destroyed in the committee's representations for the BARNES-MARTIN plan. If the Trustees, the public and the press have been the victims of misstatements adverse to the one plan they have been the victims of misstatements favorable to the other. The WELLINGTON plan is not put on the aggressive. The BARNES-MARTIN plan is put on the defensive.

In compactest form Mr. WELLINGTON'S charge is that Messrs. HOWELL, MARTIN and CLARKE palmed off on the Board of Trustees as true the figures in the first appended column, when the true figures were those in the second appended column, with the result of misleading the Board and the public to the extent indicated by the figures in the third appended column:

Real Estate, Etc.	Estimated.	Actual.	Exaggeration
1. New York real estate,	$1,797,750	$1,001,960	$ 795,790
2. Brooklyn real estate,	456 500	250,000	206,500
3. Land for storage,	448,000	None.	448,000
4. Terminal buildings,	2,300,000	300,000	1,900 000
5. New plant and machin'y	475,000	100 000	375 000
6. New cars,	400,000	236,000	164,000
Total,	$5,777,250	$1,887,960	$3,889,290

The particulars set forth as specifications to sustain this fearful charge were perused by those who read the letter yesterday and can be ascertained by recurrence to it. The charge is as serious a one as has ever been made against any public servants in this city. It is as serious if the errors be charged to negligence or ignorance as if they be charged to deliberate design, for the effect on the treasury, on public confidence and on the capacity of the committee or of the Board is the same. To suppose that such a charge can be whistled or coughed or shrugged or gestured down is simply the height of foolishness. Such a policy will be accepted as simply tantamount to confession. The citizens who make or unmake the men who in turn make or unmake bridge trustees will require that the latter shall compel Mr. WELLINGTON to his proofs or overwhelm him with disproofs. His allegations amount to more than a suggestion that from the first his plans were subjected to a policy which was meant eventually to handicap him and them and to deceive the trustees, the press and the public with what he declares to be the elaborate issue of falsifications which he implies the figures of the committee in whole and in part to be.

Obviously, a reopening, a reinquiry, a re-examination, a reconsideration of the subject is unavoidable. It will have to take place in the present Board of Trustees or at the hands of those who will succeed them as the custodians of their impeached trust. The *Eagle* is wedded to no plan, but it means to see that truth and fair play and an alleviation of augmenting public suspicions which it has done what it could to allay—but not with the success that we could wish—shall be taken into account in this matter. If the figures to justify the adoption of the BARNES-MARTIN plan are not to be trusted at all, but are a fabrication of error, accidental or intentional, from beginning to end, then the Trustees are bound to learn that fact and to let the public learn it, too. If, on the contrary, those figures are trustworthiness cannot be taken for granted any more, because Mr. WELLINGTON'S accusation that false figures were adduced to crowd out his plan from consideration raises the supposition that figures as misleading were employed to push the MARTIN-BARNES plan to the front.

From the disinterested taxpayers of Brooklyn cannot apparently be eradicated a distrust of President HOWELL'S real motive at every stage of what it is not an exaggeration to call the continuing scandal of this question. The *Eagle* has preferred and attempted to maintain that Mr. HOWELL'S personal avowal of belief in the expediency of rushing the bridge to the City Hall could be separated from his official action, and that as an official he could be relied on to respect the limits of law and public opinion as well as public interest in the premises. We still hope such is the case and are opposed to the tendency in the general mind which treats Mr. HOWELL as a suspect for cause and many of the other trustees as his dupes, with the rest as his decoys. We will not be so successful in resisting this popular impression as we might wish, if the truculent attitude of dense unintelligence, which he has initially assumed toward such grave inculpations as those, between the lines, conveyed by Mr. WELLINGTON, be not quickly abandoned by the bridge president. The MARTIN-BARNES plan cannot be a mere lure—and not be found out to be such. Accusations which impeach the very figures on which it rests cannot be ignored without being admitted. Interests behind the Board, but not of it, cannot exhibit an uncommon anxiety on behalf of sinister purposes without casting the shadow of distrust over the body itself. Within the husk of an impeached plan the kernel of a concealed one, with repudiation of promises or of law and with confiscation of vast interests enwrapped in it, cannot long be carried without detection. The one method to avert graver consequences than any sane member of the Board should care to challenge is for the trustees to insist on a reopening of the whole question. By them or by others over them it will come, because it must come.

The same issue of the *Eagle* contains an interview with Trustee CHAS. S. HIGGINS in which he says:

"I had given the matter careful consideration and had formed the conclusion in my mind that the WELLINGTON plan would give greater accomodation to a larger number of people than any other. I considered it the most suitable, not only because of the greater accommodation it offered, but because it would be a permanent improvement, which would settle the question of terminus for all time and offer the greatest attainable advantages. I went to the meeting last Tuesday prepared to vote for the adoption of the WELLINGTON plan and I was aware that other trustees were of the same mind as myself. Messrs. HOWELL, CLARKE and MARTIN handed in their report, placing the cost of carrying out the WELLINGTON plan at nearly $6,000,000. So when it came to a vote I and the others who had favored the WELLINGTON plan all voted for that of Mr. BARNES. Since the meeting I have learned that Mr. WELLINGTON claims that a very serious misstatement has been made by Messrs. MARTIN, HOWELL and CLARKE as to the cost of the WELLINGTON system. Mr. WELLINGTON declares that they have exaggerated the cost of his plan by two-thirds. I think it is the duty of the trustees to give Mr. WELLINGTON an opportunity to be heard, so that he can explain how his plan may be adopted at a less cost than $2,000,000 as he claims. I shall at the next meeting of the Board call for a reconsideration of the vote of last Tuesday by which the BARNES-MARTIN plan was adopted, and shall ask that a committee be appointed with power to employ experts. So far as I see, the cost of the WELLINGTON plan, as stated by Messrs. MARTIN and HOWELL, was the only objection to it, and that will be removed if Mr. WELLINGTON shows, as he claims he can, that the cost has been greatly exaggerated."

Irrigation in the West.

In the past five years the "Great American Desert" has been rapidly disappearing before the vast irrigating ditches of Colorado and the adjoining territories. In a letter to the New York *Tribune*, written from Fort McKinney, Wyo., Gen. JAMES S. BRISBIN calls attention to some of the more prominent features of the present and future of irrigation. The facts given below are taken from this letter.

The largest irrigating ditches, he says, are in Colorado. Of the 3,000,000 acres of land which can be fully developed only by irrigation, but 500,000 have yet been irrigated. Of the 2,500,000 acres remaining, canals to water about 1,200,000 acres are now in course of construction. Four of the larger and most successful ditches are: The San Luis Park canal, watering 400,000 acres; State Land canal, 140,000 acres; Citizens' canal, 110,000 acres; the Del Norte and Saguache canal, 150,000 acres. These lands will furnish homes for between 3,000 and 4,000 families.

Gen. BRISBIN says: "Ditching machines have been made for digging irrigating canals, but I never saw one that worked satisfactorily. The best ditching machine is an Irishman and a wheelbarrow, or a plough and a scraper."

The ordinary cost of a ditch 10 ft. wide and 2 or 3 ft. deep is said to be $1,000 per mile. Because of the moderate cost of small ditches, and the large profits on the investment, said to be 24 per cent. per annum, a large number of small companies have been organized. In Wyoming there are nearly 100 of these companies. No mention is made of the large irrigating ditches projected in Idaho, of those in operation there, in Utah, or in California, but the rapid extension of the system is predicted, and the opinion is expressed that even in our eastern states irrigation on a limited scale will finally be made use of to guard against sectional droughts.

A very interesting, and also extremely important phase of irrigation systems, is that of State rights to inter-state streams. The Governor of Nebraska recently made a protest to the Governor of Colorado against the taking by irrigating ditches of more water from the South Platte river in Colorado. The reason for the protest was the alleged fact that the Platte river in Nebraska was being dried up by this means. Gen. BRISBIN says of the message: "It shows that the water in the great rivers will one day be in contest, and their distribution on the lands along their banks become a subject of interstate legislation. The day will come when, from irrigation, the volume of water in the great Missouri and Mississippi will be materially decreased, and when one may at certain seasons of the year cross over dry shod at the mouth of streams where steamers now float, as at the mouth of the Yellowstone in Montana."

A SUMMARY of fires in places of amusement during 1887, given by *Engineering*, shows that at least 18 such places were wholly or partially destroyed during the year, with a loss of about 400 lives.

A Curious Bridge Derailment.

We are indebted to Mr. JOHN N. OSTROM, Consulting Engineer, of Dallas, Tex., for the photographs from which we have prepared the accompanying engravings of an interesting and instructive bridge derailment and of the action of guard-rails thereon. Mr. OSTROM says in his accompanying note:

"Your March 31 number contains an article on a wreck of new bridge from derailed train. Thinking it may be of interest to you, I enclose herewith

Fig. 1. Derailmen on Red River Bridge, Gulf, Colorado & Santa Fe. Ry.

blue-prints showing the effect of two derailed cars of a freight train, which struck the bridge when running about 30 miles per hour. Probably the guard-rails saved the bridge, as the train was partly ditched after crossing. The bridge was composed of two trestle approaches of about 150 ft. each, and four spans of 200 ft. each.

"It seems to me unfair to criticise a railway for an accident similar to the one you quote, for the reason that it is practically impossible to proportion a bridge that would resist the direct shock of a locomotive far enough off the track to strike the web members of bridge; a solid tubular bridge would not do it, in all human probability.

"Bridges are always in the bottom of a sag in grades, and freight trains strike them as hard as steam can carry, orders to the contrary notwithstanding. It is good fortune if the guard-rail does its duty—if it does not, the destruction of bridge is almost certain.

"I was Bridge & Div. Eng. on the road (the Gulf, Colorado & Santa Fé Ry.) during construction, in 1886-7. The wreck occurred after the bridge was finished. No harm was done except to the guard-rails as shown in photographs."

Details not given in the engravings nor above are these. Both inside and outside guard-rails were 6×8i-n. pine, laid flat, and "dapped" or boxed out for the ties, 2 ins. The outer guard-rail was protected on the trusses only, but not on the approaches, by a 4×4×⅛ in. angle plate. The ties were 6×8 ins. by 10 ft. long on the approaches, and 8×8 ins. by 12 ft. long on the bridge proper, spaced 6 ins. apart in the clear. The first tie of the approach was badly shattered and cracked throughout, as shown in Fig. 2.

By the way, the term "dapped" used as above by our correspondent, although not entirely new to us, is, we understand, not in very general use, and it is very desirable that there should be, as nearly as possible, uniformity in the use of such technical terms. What may be called the standard designation for such construction as shown and described, is that the tie is *gained* into the guard-rail, and the latter *boxed out* to receive it. If we are wrong in believing that these are more nearly than any other the standard expressions we are open to correction, but it is obviously desirable that there should not be confusion in such terms.

The course of events in the derailment is tolerably clear. The wheels had been running for some unknown but probably considerable distance tolerably close to the rails and when they first struck the bridge floor were in admirable position to be replaced at once on the rails by a Latimer or other rerailing guard without any shock or damage. As it is, the damage was insignificant, but that should not blind us to the fact that, as the engravings show, this was only a fortunate accident, and all the conditions were present for a very serious disaster.

The wheels had been running tolerably smoothly over the ties, as shown by the almost imperceptible marks in the foreground of Fig. 2, which is a faithful reproduction, when they struck the first bridge tie over the too common excessive gap at such points, and shattered it badly. Both derailed wheels struck the end of the unflared guard-rails, one on the inside and one on the outside, as shown by the tie-marks between the rails, but some conservative tendency caused the outer wheel to run up as close to the guard-rail as it could, after the first erratic movement. Probably it was on the rear axle of a truck. So the wheels ran for 150 ft.

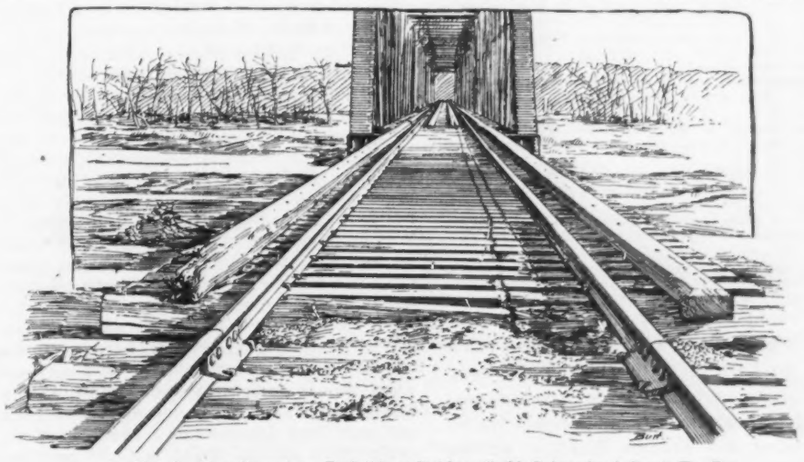


Fig. 2. Derailment on Red River Bridge, Gulf, Colorado & Santa Fe. Ry.

The result when the inside guard-rails were struck, at the entrance to the bridge proper, is shown in Fig. 1. Here also Providence was unnecessarily tempted by ending them short, without attempt to converge them on a bevel. The inner wheel took the inner guard all right but the outer wheel struck the guard fair in the middle, and split it lengthwise for some distance, with the chances immensely in favor of its finally jumping off on the wrong side, and so causing a wreck by the very fact of its existence. It did not do this, but finally took a big piece out of the right side of the inner guard-rail and the rest of the bridge was passed over uneventfully.

Therefore, it may be feared, the lesson was not, and will not be fully appreciated; although really the moral is as plain as if there had been a tremendous wreck which cost a score or two of lives, as there was at the White River disaster, only a little less than a year ago, from precisely the same cause.

The Overflowing of the Yellow River.

A correspondent of *Indian Engineering* gives some facts regarding the overflow of the Yellow river, which, owing to its recent outbreak, are of special interest.

It is stated that the land to the north of the river is higher than on the opposite side, so that in high water there is a constant tendency for the river to overflow and submerge the low plains on the southern side.

Probably owing to previous neglect of the river banks, it is said that in the thirteenth century the river abandoned its northern channel, and caused great havoc in the low-lying plains to the south. The plains to the north, no longer watered by the river, became barren and desolate, and with floods on one side, and drought on the other, great suffering was caused in these provinces.

After the invasion of the Mongolians, the great KUBLAI KHAN set matters along the river to rights by repairing the river-banks, and cutting a canal from Pekin to Tung Chang Fu, near the termination of the old canal which connected the Yangtse and Yellow rivers. This new canal served a double purpose, as it not only drew off some of the surplus waters of the Yellow river, thus preventing further floods, and again watering the country which had been left barren, but also did important service as a commercial water-way.

In the latter part of the eighteenth century there was further trouble with the overflowing of the river, which continued for some time before the Government succeeded in placing it under control. To restrain the floods, the river was diverted into two main channels, and dykes were built. The latter were not long kept up, as the material used, *millet stalks and sand*, was so unsubstantial that it must often be replaced at a considerable cost.

In later years, it is well known that much trouble has been given by floods along the Yellow river, and it seems probable that they will continue until a more liberal policy is adoped by the Chinese Government. The old method of building and repairing the embankment is still continued, with but little advance. The millet stalks are now tied in bundles, and are loaded with bags of sand.

The Chinese government has employed foreign engineers to make surveys and plans for the improvment of the river. Recommendations have been made previously for the improvment of the river on sound engineering principles, but sand and millet stalks are so much cheaper than the stone and lime necessary to make rip-rap and concrete embankments, that it is feared the great difference in cost will influence the authorities to continue in the old way.

THE Directors of the Chicago, Milwaukee & St. Paul R. R. have elected ROSWELL MILLER, President.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XIX. Saturday, April 28 1888

D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

American Society of Civil Engineers, New York.—Regular meeting, May 2. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, o. —Regular meeting, May 2. "Standards of Boiler Efficiency", Col. E. D. Meier; "Failure of a Firmenich Boiler", C. F. White. Secy., W. H. Bryan, 709 Market St.

Engineers' Club of Philadelphia, Pa.—Regular meeting, May 5. Secy., Howard Murphy, 1123 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, May 7. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, May 7. Secy., Geo. L. Wilson, City Hall.

American Society of Mechanical Engineers.—Next meeting at Nashville, Tenn., May 8 to 11. Secy., F. R. Hutton, 280 Broadway, New York City.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, May 15. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass. —Regular meeting, May 16. "Small Pipe Sewers." Secy., S. E. Tinkham, City Hall

Master Car Builders' Association.—Next convention at Alexandria Bay, N. Y; commencing June 12. Secy., M. N. Forney, 15 Broadway, New York City.

American Railway Master Mechanics' Association. —Next meeting at the Thousand Islands, N. Y.; June 19. Secy. Angus Sinclair, Chicago.

Roadmasters' Association of America.—Next meeting at Washington D. C. Sept. 11. Secy. H. W. Reed, Waycross, Ga.

THE rapid growth of our business in the past fifteen months, with the large additions which we have made to our staff, has compelled us to move into larger quarters, and after May 1 we will be found in rooms 103, 104 and 105 of the Tribune Building, on the seventh floor. Our readers will, we are sure, be interested in our recalling that at the close of 1886 we were occupying just one office of 12 by 15 ft.; our new offices occupy almost the entire south front on one floor of the main portion of the building, and for convenience of location, and beauty of outlook are hardly excelled in this city. We shall be glad at all times to see in them any of our friends and subscribers, and trust we shall never find it necessary to move again, since there is now more room on each side of us.

We may add that all our subscribers may at any time make appointments, or have mail directed to our care at the above offices, where they will find a reception room at their service, among other features of which will be a complete set of the latest and most valuable technical books. We do not often talk about ourselves in our columns, but the occasion seems to warrant us in once for all thanking our rapidly growing clientage for the aid they are giving to our efforts to build up in this country what the character of our field demands, the greatest engineering journal of the world; a journal which shall be at all times and on all questions coming within its scope fearless, impartial, just, progressive and alive.

IT appears to be the fore-ordained mission of this journal to keep the Board of Trustees of the New York and Brooklyn Bridge from being imposed upon by what would seem to be the invincible ignorance or carelessness or worse of their Terminal Committee. It is an honorable mission, and a necessary one, and we shall not shrink from it, so long as it is the public interest and safety, and in no sense private interests, which we are called on to defend, though it grows a little wearisome and onerous at times. Our proper course in the matter has been made plainer by the absurdly impracticable features of the plan which has been adopted in such an obviously improper way. The fact that one of the editors of this journal happens to have some personal interest in the matter has caused us to feel no little doubt as to our proper course, since we are determined that there shall be room for no shadow of just suspicion that the columns of this paper are used in any way to further private interests of any kind or of any person whatever. Our readers will bear us witness that heretofore we have said very little in the matter, beyond the bare chronicle of current news and of what were, or were supposed to be, final conclusions and results. No case of mere official impropriety, however flagrant; no mere error of judgment, however clear, where there was real room for choice, would cause us to swerve from this policy. But the question of how to enlarge the capacity of the Brooklyn bridge is at present the largest and most novel engineering problem pending; and its settlement bids fair to become something of a *cause célèbre* in engineering. We cannot in justice to our readers keep it entirely out of our columns; and when we find that persons in authority, for some unknown motive of their own, have been so little affected by one severe lesson, administered by us in June last, as to adopt a plan so far inferior to their first folly as to be impracticable even for a day or an hour, and when this is done with even more indecent haste, and under vastly more discreditable and suspicious circumstances, the duty of an engineering journal which is to be such in fact, and is to be worthy of its clientage, is clear. It cannot do less than to expose the technical absurdities of such action, as it would in any other case. That we have done, as fully as seemed at all necessary, in another column. Whether it should go further and expose in these columns strong reasons not yet made public, for believing that it was not simply ignorance, but intentional bad faith, which led to such proceedings, we have not yet decided.

THIS we may say, that on the basis merely of the facts published last week, it is possible to avert the charge of deliberate deception and bad faith only by assuming such colossal carelessness or ignorance as to unfit any man for responsible trusts. The point in question is in no sense one of the mere size of an estimate for specified work; whether it shall be one million, or two millions, or three millions. All engineers understand that there is often plenty of room for differences of opinion on these matters, and that the larger sum has an annoying tendency to eventually prove the correct one. The charge is something quite different from this: that false items aggregating nearly $4,000,000, for which there was absolutely no foundation or necessity, were inserted in a comparative estimate which was sprung upon a non-technical body at a moment's notice, with a request, which was acceded to, for immediate action; that, for example, there was inserted about $1,000,000 for desirable street improvements which had no necessary connection with the plans whatever, since the land could be left uncondemned and built on if desired; that $448,000 was charged for storage ground when there was more already owned than there was possible use for; that $2,200,000 was charged for buildings against one plan when only $260,000 was allowed for the other, which needed twice the track-room and equal platform space, one pair of buildings being elaborate and costly structures in no way required if not wished for, and the other mere sheds; that $475,000 was put in for machinery when there was nothing to do but to move a few cable sheaves; that more new cars was charged against one plan than the other when it admittedly needed less for equal accomodation.

SUCH falsifications of fact bear no relation to the ordinary differences of opinion as to what work will cost which admittedly must be done. And when to this we add the fact that these differences refer only to the largest and most expensive plan, and that there were two other and much cheaper plans which yet would have given far more capacity than the one put in contrast with them, and that all three of these plans effected operating economies paying interest on over $4,000,000 (or beyond question a very large sum) of which no mention whatever is made in the comparison, the circumstances become additionally suspicious.

We make no allegations as to motives. The gentlemen whose actions are impeached have heretofore borne excellent reputations, and may be able to so explain their acts as to continue to do so. Not we, but the facts impeach them. But when we add that the gentleman who so conveniently forgot the smaller plans and condemned the larger on account of length of train and the expense, had advised in writing only a few days before the reports were to have been made public, "to strike out everything relating to the 14-car plan, as all really included in the larger scheme for 18 cars, and by so doing the paper is made clearer;" which advice was unfortunately taken after the matter was in type, it certainly seems as if the chief gain in clearness was a clearer road to plausibly forget the smaller plans and object to the number of cars and the cost. To be sure, all men may change their minds honestly, from honorable motives, after however positive expressions, but when they do so honestly, they do not as a rule do it in secresy and haste, on their own individual judgment, in defiance of advice which they have themselves sought from experts of their own selection, and without even communicating to any of those concerned the fact that they have changed their mind. Rather, they will consult with those concerned, under such circumstances, merely for appearance sake, and for fear of error, especially when about to venture a second time on unfamiliar ground which they have once found treacherous.

Beyond this brief summary, which we have deemed to be demanded by the circumstances

and by the interests of the profession, we shall not go until the event is decided, except to chronicle current news.

THE ordinance granting the Reading Terminal Company the right to build the elevated road in the city of Philadelphia, referred to in last week's issue, is now before the City Council, who will doubtless deliberate over it with the usual exasperating slowness of municipal bodies. We are glad to record, however, that there seems to be a growing public sentiment in the direction suggested last week, the abolition of the present surface tracks, as a return for the franchise permitting the construction of the new elevated line, and it is to be hoped that an amendment to this effect will be added to the ordinance. The *Press* published a list of the grade crossing fatalities to people other than employes during the year from April 10, 1887 to April 10, 1888. The total number killed at grade crossings was nineteen. The number killed while walking on the track at other points than crossings is also said to be large. The general provisions of the ordinance are given upon our Engineering News page.

Either the agitation over the Reading Terminals or some other unusual cause has awakened the Philadelphians to a remarkable degree of activity. On the same day on which the Reading ordinance was introduced into Councils, two other vitally important matters were taken under consideration. One is an ordinance authorizing the Mayor to appoint a commission of from three to five members "to examine the present system of sewerage, and to present plans for the betterment, if the same be desirable in their judgment, at the earliest date practicable, provided that the cost shall not exceed $5,000." Perhaps the question whether the sewerage system of Philadelphia is susceptible of improvement is still an open one in the minds of the Philadelphia councilmen. It is certainly easily settled in the minds of any person gifted with a sense of smell of ordinary power in discerning corruption. It is to be fervently hoped by any well wisher to the health of the Quaker City that the move for better sewerage may not be as long in reaching from words to deeds as have the demands for a pure water supply and endurable pavements.

We are glad to record, however, that the matter of pavements was the second one referred to above. A communication received from Mayor FITLER stated that after conference with representatives of the city railroad companies and the city solicitor, he was satisfied that if an appropriation was made, the work of repaving the streets on which the horse and cable lines ran might be inaugurated at once, at a cost to the city for good Belgian block pavement of not more than $1.50 per sq. yd. He recommended an appropriation of $300,000 to be made. By the franchise under which the Philadelphia street railroads are operated, the companies are obliged to contribute a certain portion of the cost of laying and maintaining good pavements on the streets where they have tracks. Up to the present time this provision has practically been a dead letter. Indeed, we believe, it has been stated by city officials, that it would cost more to enforce the ordinance than to do the paving, *hence* the city has heretofore laid cobble-stone paving at its own expense. The city government as reorganized, however, has given many promises of reform and it is to be sincerely hoped that these first moves in the direction of efficiency may be pushed rapidly into execution. There can be little doubt that with good paving on the principal streets, the present public apathy on the subject will lessen and there will be a general demand that the present covering of misshapen pebbles which at present obstructs traffic in the streets of Philadelphia will be replaced everywhere by blocks, asphalt, macadam, telford or bricks.

THE New York Central Railroad Company, which has sometimes been rather behindhand in introducing improvements in methods and practice, is now doing some very commendable work upon its bridges. Old short spans are being renewed with riveted girders with a very efficient substitute for a buckle plate floor. All iron trusses are kept under constant surveillance and old members which were designed for lighter loads than those now in vogue, are being renewed at the rate of 8,000 tons per year, besides numerous complete renewals. This example might be profitably followed by a very large number of railroad companies. Especially in the matter of short spans is it true that economy and safety is to be found in the long run by the use of riveted girders with substantial floors rather than by the use of short panel trusses.

The Forthcoming Manual of American Water-Works.

There is perhaps no kind of class publication more generally useful and more frequently referred to, by those who have any use for it at all, that the Manuals giving in small compass all the salient facts of great special interests. The great exemplar of such manuals is perhaps Poor's *Manual of American Railroads*, which has grown from an insignificant beginning twenty years ago, to an immense book of reference which is indispensible to those having anything to do with railroads, and which if it were to suddenly stop, would reveal to many men, what they hardly think of now, how great an aid it is to them in their daily work. While such interests are young, men get along without such aid somehow, for the very good reason that they have to do so, but when the need has once been supplied, they soon begin to find it a practical necessity.

The next greatest single interest in this country is probably the water-works interest, and to fill the same need in some degree we began in 1883 the publication of "Statistical Tables of American Water-Works," which were compiled for us by Mr. J. JAMES R. CROES, C. E., of this city, and which were so generally appreciated that three successive revised editions of them have been issued since. The success of this work has encouraged us to greatly enlarge its scope, and to publish hereafter what will be known as the "Engineering News Manual of American Water-Works". As with most such works, many of those concerned will hardly begin to appreciate how much use they have for a complete work of the kind until they get it, but that they appreciate it pretty fully, nevertheless, our past experience shows.

We wish, therefore, to call the especial attention of every man who is interested in water-works, to the fact that we are compiling such a new and complete Manual, and that it will describe, as they now stand, the water-works of every city and town in North America, having a public water supply system completed, under construction or projected with fair prospects of being built.

The demand which even now exists for a correct and complete Manual of the kind, and the manifest advantages that such a book will have for all water-works men, has led us to spare no pains in collecting and compiling the fourth edition of what we have previously published under the less comprehensive title of "Statistical Tables of American Water-Works;" but everyone who has attempted a work of this kind knows how difficult it is to obtain full and uniform reports from a large number of widely scattered interests, and that, even if the attempt is continued year after year, many will not be up to date. When we began work on the Manual we found that, from some water-works, reports for the "Statistical Tables" had not been received for several years, and the first thing to do was to bring up every report to date. With this end in view we have written to every water-works in the United States and Canada enclosing a copy of all the data we have concerning their works, and urging them to correct it to date and make such additions as were necessary for absolute completeness.

We, therefore, wish to call the especial attention of delinquents to the fact that a very considerable number of water-works have not yet responded to our requests by returning the above mentioned data corrected and amplified, and to request them to do so at once, as a correct report from each water-works will prove greatly to the advantage of the sender, and will be of value to all other water-works men as well. We must have such reports in some way, and thanking heartily the large majority who have promptly responded to our appeals, we ask the others if they, too, will not join the procession speedily.

We also especially wish for advices as to any new water-works in progress of erection or projected, that we may include these in our Manual.

A few words may be added, perhaps, regarding the Manual itself. Its main subject matter will be arranged in tables, by States, but for convenience in making summaries the classification of States will be by geographical sections instead of in alphabetical order, as formerly. As has been stated, there will be a list by States of works which are projected or in progress, and also a table showing the yearly growth in numbers of water-works in this country, the growth for 1887 being illustrated graphically by the aid of a map showing the location of new works for that year. The Manual will contain complete tables of summaries and also deductions in the text illustrating and emphasizing all the important conclusions which can be drawn from the data presented in the reports; in fact, a digest of all the data obtainable concerning the water-works of our country. Articles will be given, likewise, upon the organizing of water companies, and the preliminary steps necessary in locating a source of supply, contracting for and constructing, and maintaining and extending them when completed. A directory of water companies and their officers, of hydraulic engineers, of water-works contractors and manufacturers of water-works supplies, together with much indispensable information for water-works men will be additional features.

After this summary, we trust we shall hardly need to ask again the coöperation of all interested in water-works in making the work complete, but we again especially request those who have not sent in a report of their works to do so at once.

The Water-Works Convention.

The Convention of American Water Works Superintendents held last week in Cleveland, O., was notable in point of numbers attending—some of the members coming from as far away as Denver and Colorado Springs, from New Orleans and from Atlanta—while the presence of such notable hydraulic experts as FANNING, HERMANY, TUBBS, BENZENBERG, WHITELAW and GERECKE, besides many others of well known ability in their special field, gave to the meeting an importance, which

under other circumstances it might not be entitled to. The papers were all of a high character, valuable for the amount of practical instruction and suggestions they contained, and the Association is to be congratulated on having in its ranks men who are willing to take from the busy hours of their fully occupied days the time necessary to prepare such well considered essays for their brethren, who in turn, let us hope, cannot fail to be stimulated to go and do likewise in the coming year. Much credit is to be given for this result, in the prudent choice of a place of meeting. A more central or accessible place than Cleveland is not easily to be found, hotel accommodations being excellent and the prices reasonable. In these two latter respects the Association was most favored, and from our personal experience we know how very important a part they play in the success or failure of a Convention.

The exhibits of the Associate Members formed a new and most important feature at this Convention, and its complete success insures its continuance in more generous proportions at similar future meetings, thus adding new dignity and importance to such assemblies as well as proving a great convenience and a source of profit to the Association.

Considered socially, the meeting throughout was of a most genial and enjoyable character; these men, who are themselves mainly constructed on the "gravity system" were apparently glad to get away for a brief week from the eternal "pressure" of their daily lives, and have a good time generally with kindred souls. We are sure that, as we write, each one of them is better equipped intellectually for the duties he returned to, by reason of his short holiday, and each Water Department or Company which they are serving will be repaid many fold in the coming twelve months for the week's absence of their Superintendent. Let us hope that in the estimates of the next year, each such Department or Company will include a liberal allowance to send their Superintendent to the Louisville meeting.

We give up a large part of our space this week to a full report of the proceedings.

The Past and Future of New York.

There is no phase of modern civilization more remarkable than the phenomenal growth of cities, nor is there any of equal importance which has been less thoroughly and systematically studied. For the correct and rational projection of almost every kind of engineering work, as notably every form of municipal improvement, and in less degree of lines of internal transportation, some reasonably correct forecast of what growth the next two or three decades will show is of extreme importance, yet it is often the last thing studied, and when a study is attempted at all, it is often hasty and perfunctory; one reason for which may well be that such a study, to be of any worth, requires a laborious comparison of multitudinous statistics, and is in a line of investigation somewhat outside of the routine of engineering work, and for which the latter is not in itself an especially good preparation.

For these reasons, and because there happens now to be several different public improvements of magnitude now under active consideration in New York and its immediate neighbors which are really a part of it, we have determined to make as careful a study as possible of the past and future of this metropolis, so far as the future can be judged by the past, and in doing so to make the facts of ecord by which any one else can check these conclusions or form his own independently. To do this effectively necessarily requires a more or less careful comparative study of what may be called the older and younger sisters of New York—London, Philadelphia and Boston, so that a study of one may be called in a measure a study of all four cities. And as the laws of municipal growth are more or less common for all cities such a study has a certain application also to cities like Chicago, St. Louis, Cincinnati, etc.; enough at least to be an excellent foundation for a like study of their past and future, which we shall hereafter attempt, although those cities are too modern, and have grown up under too dissimilar conditions from New York, to make the facts in regard to them of particular value in forecasting the future of New York.

We give on the following pages a mass of figures which we realize may only serve to repel the careless eye, yet which tells a story which is well calculated to fire the imagination as well as instruct the judgment, because it not only shows beyond the power of doubt that New York is destined in the early future to become the greatest city of the world, as is generally admitted, but enables one (in connection with some further figures which we have yet to present) to form a tolerably close estimate of when this is likely to come about, and how the population will be distributed on the area surrounding Manhattan Island where the growth must chiefly be. For, by the term "New York", when not otherwise qualified, will hereafter be understood in this discussion the entire area which makes up the metropolis, including Brooklyn, Jersey City, Newark, etc., and not the mere political New York, which will be designated as Manhattan Island. The "annexed districts" of Westchester Co. has been included in the statistics for 1880 with Westchester Co., as it was in all preceding censuses, for equality of comparison.

The growth of the entire city population of the United States, by comparison with the entire population is shown in Table VII. In Table VIII. are given analogous facts in regard to England, France and Germany. Regarding as "cities" all places of over 8,000 inhabitants, according to the census classification, the steady increase in the proportion of city population from 3.3 per cent. in 1790 to 22.5 per cent. in 1880—so rapid an increase that the difference in percentages themselves rapidly increase—is one of the most remarkable features in all the tables given. Whereas the decimal increase of total population (except for the check due to the war) has been practically constant at 32.7 per cent. the increase of city population has been 64.1 per cent.

Were the same ratios to continue it would take comparatively few decades to bring the entire population into cities, which is absurd. There is a certain natural superior limit to the growth of cities, which we can readily see to be that enough must remain in the country to raise food for the entire population. Taking the world as a whole, only those thus needed will do so. The rest will flock to the towns where most of the other industries of man are most conveniently carried on, and engage in those occupations which minister to the comforts, taste and luxury of man, rather than to his bare subsistence. As the higher wants of man are boundless, whereas, on the other hand, the amount of food that any man can consume is strictly limited, we may be quite sure that no more men will till the ground than are needed for the latter end. As agriculture improves, and machinery takes the place of human labor the town population will advance. As the mechanical skill of a country advances, so that it can supply other peoples as well as its own with the higher products of human labor, the town population will likewise increase, and in small regions, like England and New England, this may well go, as it has gone, to the point that not nearly enough people are left in the country to supply food, which has to be obtained by importation. In England and Wales, as shown by Table VIII, the town population has reached the enormous aggregate of over 60 per cent. of the population. In New York and New England the proportion must be even larger. We have not compiled the exact figures.

Nothing like this is possible of the United States as a whole, which will probably always be a food-exporting, and almost certainly a self-sustaining nation. On the other hand, in no other country in the world is so little human labor used to produce a bushel of wheat or other product of the earth, because of the excellent agricultural machinery, while the ingenuity and mechanical aptitude of the people is so great as to make it probable that an increasing proportion will be diverted from agriculture, as manufacturers become more firmly established. It is, therefore, a tolerable certainty that the very moderate estimate given of the future growth of *city population of the United States as a whole*, increasing from 22.5 per cent. of the whole population in 1880 to only 31 per cent. in 1950, will be more than realized, while it is the opinion of the best statisticians that the figures given for total population are likewise reasonable. 300,000,000 seems a large population to have even 62 years from now, but it would still give a population of only 100 inhabitants per square mile, whereas that of France, which is on the whole a self-supporting country agriculturally, is 181 per square mile.

This leads to the striking conclusion that the TOTAL city population of the United States is likely to about double between 1880 and 1900, and to again double between 1900 and 1920, so that in or about that year it will be four times that of 1880.

The population of New York City has heretofore grown very much faster than that of the country at large, as will be seen by comparing Table III with Table VII. Whereas, the whole population has increased since 1820 at the average decimal rate of 31.7 per cent. that of Manhattan Island only has been 45.3 per cent. and that of the whole Metropolis, properly so called, has been 48.2 per cent. This growth has been far more rapid than the growth of Boston and Philadelphia (Table V.) which, as will appear more fully from a table which we shall give next week, has been 35.7 only for Philadelphia, and 31.9 per cent. for Boston proper, or including the suburbs also (as it is more just to do) 43.9 per cent.

Is this increase likely to continue; and if it does at what figures will the population of New York arrive and where will the added population live? That is the question we have set ourselves, but it is more easily asked than answered. In Tables I., II, and III, we give about all that the past can tell profitably for the century preceding 1880, and in Table IV., what is on the whole the most reliable evidence as to recent tendencies for the seven years succeeding 1880. The parsimony of our Government, in refusing to take a census every five years instead of every ten, as was strongly urged by the last Superintendent of the Census, makes an investigation of this kind more difficult, especially at this time in the decade, but we have to take such data as exist.

The pressure on our space is so great this week that we are unable to continue our discussion in this issue.

TABLE I.

POPULATION OF THE VARIOUS COUNTIES AND SECTIONS MAKING UP THE METROPOLIS OF NEW YORK, IN EACH DECENNIAL CENSUS, 1790 TO 1880 INCLUSIVE.

	1880	1870	1860	1850	1840	1830	1820	1810	1800	1790
Hudson Co., N. J.	187,944	129,067	62,717	21,822	9,483	—	—	—	—	—
Bergen Co., "	36,786	30,122	21,618	14,684	13,223	22,414	18,178	16,603	15,156	12,601
Passaic Co., "	68,860	46,416	29,013	22,538	16,734	—	—	—	—	—
Union Co., "	55,571	41,859	27,780	—	—	—	—	—	—	—
Essex Co., "	189,929	143,839	98,877	73,944	44,621	41,928	30,793	25,944	22,269	17,785
Total, New Jersey	539,090	391,303	240,005	132,988	84,061	64,342	48,971	42,587	37,425	30,386
New York Co.	1,164,673	942,292	813,669	515,547	312,710	203,007	123,706	96,373	60,489	33,131
Westchester Co.	150,614	131,348	99,497	58,263	48,686	36,456	32,638	30,272	27,428	24,003
Total, N. Y.	1,315,287	1,073,640	913,166	573,810	361,396	239,463	156,344	126,645	87,917	57,134
Kings Co.	599,495	419,921	279,122	138,882	47,613	20,537	11,187	8,303	5,740	4,495
Queens Co.	90,574	73,803	57,391	36,833	30,324	22,276	21,519	19,336	16,891	16,014
Total, Long Island	690,069	493,724	336,513	175,715	77,937	42,813	32,706	27,639	22,631	20,509
Richmond Co.	38,991	33,029	25,494	15,061	10,965	7,084	6,185	5,347	4,563	3,835
Total Metropolis	2,583,437	1,991,696	1,515,176	897,574	534,359	353,702	244,206	202,218	152,536	81,864
P. C. Increase, as below,	29.5	27.8	62.7	66.8	48.4	44.8	20.8	31.9	87.3	
" N. Y. State,	15.9	12.9	25.2	27.5	26.5	39.8	43.0	62.8	73.1	
" New Jersey,	24.8	34.8	37.2	31.1	16.3	15.61	2.9	16.2	14.6	
" London,	17.2	16.4	18.7	26.2	23.5	23.51	9.2	19.2	—	

Remarks:—In order to make the comparison a strictly fair one the population of the entire counti s given is included throughout. This includes some considerable areas which are even now chiefly farming regions, but no considerable population. The situation of the counties is shown on the small scale map. There are certain small discrepancies in the figures for population for the various censuses. These are explained from the volume for each census.

The various counties are as follows:

Hudson Co. Chiefly Jersey City and Hoboken.

Bergen Co. All small suburban townships, the largest being Englewood and Lodi.

Passaic Co. Chiefly Paterson (51,031) and Passaic (6,532).

Union Co. Chiefly Elizabeth (28,229), Plainfield and Rahway.

Essex Co. Chiefly Newark (136,508), Orange (13,207).

New York Co. Manhattan Island only. The population of the annexed wards (23 and 24, 41,626 in 1880) has been substracted from N. Y. Co. and added to Westchester Co. in 1880, in order to preserve equality of comparison.

Westchester Co. Extends 43 miles up the river, but the population is nearly all suburban. Yonkers (18,892) and Peekskill (6,893), chief towns outside of annexed wards.

Richmond Co. Consists entirely of Staten Island. Population chiefly at north end.

Kings Co. Chiefly Brooklyn (566,663) with the country towns of Flatbush, Flatlands, Gravesend, New Lots, New Utrecht.

Queens Co. Chiefly Long Island City (17,129) Flushing (15,906) Hempstead (18,164). The county extends out some distance on Long Island, but the population is mostly at the extreme west end.

TABLE II.

INCREASE OF POPULATION IN DECENNIAL PERIODS FOR VARIOUS SECTIONS OF THE METROPOLIS OF NEW YORK, 1790 TO 1880.

	1870 to 1880	1860 to 1870	1850 to 1860	1840 to 1850	1830 to 1840	1820 to 1830	1810 to 1820	1800 to 1810	1790 to 1800
Hudson Co.	58,877	66,350	40,895	12,339	—	—	—	—	—
Essex Co.	46,090	44,962	24,933	29,323	3,693	11,135	4,809	3,715	4,484
Other Cos.	42,820	39,986	41,189	7,265	17,026	4,236	1,575	1,447	2,550
Total N. J.	147,787	151,298	107,017	48,927	19,719	15,371	6,384	5,162	7,039
Manhattan Island	222,381	128,623	298,122	202,837	109,703	79,301	27,333	35,884	27,358
Westchester Co.	19,266	31,851	41,234	10,577	12,230	3,818	1,366	2,844	3,425
Total N. Y. proper	241,647	160,474	339,356	212,414	121,933	83,819	29,699	38,728	30,783
Kings Co.	179,574	140,799	140,240	91,269	27,076	9,350	2,884	2,563	1,245
Queens Co.	16,771	16,412	20,558	6,509	8,048	757	2,183	2,445	877
Total Long Island	196,345	157,211	160,798	97,778	35,124	10,107	5,067	5,008	2,122
Staten Island	5,962	7,537	10,431	4,096	3,881	899	838	784	728
Total Metropolis	591,741	476,520	617,602	376,215	180,657	109,496	41,988	49,682	70,671

TABLE III.

PERCENTAGES OF GROWTH OF POPULATION FOR VARIOUS SECTIONS OF THE METROPOLIS OF NEW YORK, IN DECENNIAL PERIODS, 1790 TO 1880.

	1870 to 1880	1860 to 1870	1850 to 1860	1840 to 1850	1830 to 1840	1820 to 1830	Av'ge. 1820 to 1880	1810 to 1820	1800 to 1810	1790 to 1800
Hudson Co.	45.6	105.8	187.4	130.1	—	—	—	—	—	—
Essex Co.	32.0	45.5	33.7	(65.7)	(6.4)	36.2	35.4	18.5	71.4	20.3
Other Co's.										
Total, New Jersey	37.8	63.0	80.5	58.2	30.7	31.4	49.2	15.0	11.4	25.8
Manhattan Island	23.3	15.8	57.8	64.9	54.0	30.3	45.3	28.4	59.3	82.6
Westchester Co.	14.7	32.0	70.8	19.7	33.6	11.7	29.0	7.8	10.4	14.3
Total, N. Y. proper	22.5	17.6	59.1	58.8	50.9	53.3	42.6	23.4	44.1	53.9
Kings Co.	42.8	50.4	101.0	191.7	131.8	83.6	94.2	34.7	44.7	27.7
Queens Co.	22.7	28.6	55.8	21.5	36.1	3.5	27.1	11.3	14.5	5.5
Total, Long Island	39.9	46.7	91.5	125.5	82.0	30.9	66.2	18.3	22.1	10.4
Staten Island	18.1	29.6	69.3	37.4	54.8	14.5	35.9	15.7	17.2	19.0
Total Metropolis	29.7	31.4	68.8	68.0	51.1	44.8	48.2	20.8	31.9	87.3
N. Y. State	15.9	12.9	25.2	27.5	26.5	39.8	24.4	43.0	62.8	73.1
New Jersey	24.8	34.8	37.2	31.1	16.3	15.6	20.4	2.9	16.2	14.6
London	17.2	16.4	18.7	26.2	23.5	19.2	21.5		small	

TABLE IV.

NEW BUILDINGS ERECTED, CITY OF NEW YORK 1868-1887.

(In 1868 to 1872 inclusive the cost of building was abnormally high.)

Years.	Total No Bdgs.	Av. per Year.		Av. Val. per Bdg.
Date.	No.	No.	Value 1=$1000	No.	Value 1=$1000	
1868-70	3	6,713	109,539	2,238	36,513	16,310
1871-75	5	8,615	130,301	1,72	46,060	15,1.0
1876-80	5	8,800	96,171	1,760	19,234	10,930
1881-85	5	14,147	219,424	2,829	43,865	15,510
1886-87	2	8,471	125,819	4,235	12,910	14,890
Private Dwellings.						
1868-70	3	3,354	49,941	1,118	16,647	14,890
1871-75	5	2,838	40,635	568	8,127	14,910
1876-80	5	3,744	37,270	755	7,454	9,870
1881-85	5	3,638	50,435	724	10,087	13,930
1886-87	2	2,497	37,236	1,239	18,618	14,900
1888-90	Est	3,600		1,200		
Tenements.						
1868-70	3	2,062	25,539	687	8,513	12,390
1871-75	5	3,884	46,962	777	9,392	12,090
1876-80	5	2,358	23,061	472	4,612	9,770
1881-85	5	3,982	51,302	796	10,260	12,890
1886-87	2	1,298	13,476	649	9,738	10,380
1883-90	Est	1,800		600		
Apartment Houses and Flats.						
1868-70	3	1	150			15,000
1871-75	5	115	3,158	23	632	27,480
1876-80	5	749	14,950	150	2,990	19,930
1881-85	5	2,019	59,410	404	11,882	29,410
1886-87	2	2,297	48,932	1,149	24,466	21,290
1588-90	Est	3,600		1,200		
Business, Hotels and all other Buildings.						
1868-70	3	1,296	33,909	432	11,303	26,170
1871-75	5	1,780	39,546	356	7,909	22,220
1876-80	5	1,919	20,800	384	4,178	10,880
1881-85	5	4,518	58,177	902	11 635	12,900
1886-87	2	2,379	26,175	1,190	13,087	11,000
1888-90	Est	3,000		1,000		

Summary.

Class of Residence.	Decade 1871-80	Decade 1881-90. Actual to 1887.	Decade 1881-90. Estimate.	Decade 1881-90. Total.	Per cent increase
Dwellings.	6,612	6,135	3,600	9,735	47.2
Tenements.	6,242	5,280	1,800	7,080	13.4
Apartment H..	862	4,316	3,600	7,916	818.3
Total Res'ces	13,716	15,731	9,000	24,731	80.3
Business.	3,699	6,887	3,000	6,887	186.1

At the beginning of the period covered by this table there were about 14,000 tenements in New York.

Remark.—This table appears to indicate that the population of Manhattan Island will be increased about 80 per cent. more in the decade 1880-90 than it was in the decade 1870 80, or 400,286, which will make the population in 1890 1,561,959, an increase of 34.37 per cent., against only 23.3 per cent. in the previous decade.

TABLE V.

POPULATION OF BOSTON AND PHILADELPHIA BY DECENNIAL PERIODS.

Date.	Boston. Suffolk Co.	Boston. 3 Count'es	Boston. Decenn'l Increase	Philadelphia. Popula-tion.	Philadelphia. Decenn'l Increase
1880	387,929	742,780		847,170	
1870	270,802	593,670	149,119	674,022	173,148
1860	192,700	482,177	111,493	565,529	108,493
1850	144,517	351,409	130,768	408,762	156,767
1840	95,773	234,728	116,681	258,037	150,725
1830	62,163	175,622	59,106	188,797	169,240
1820	43,890	141,833	33,789	135,617	53,160
1810	34,381	118,415	23,418	111,210	24,427
1800	28,015	102,159	16,256	81,009	30,201
1790	—	87,612	15,547	54,391	26,618

The three counties which are assumed above to make up metropolitan Boston are, Norfolk, Suffolk practically Boston proper only), and Middlesex, with the city of Lowell excluded. Philadelphia is for the city only, not including Camden or suburbs.

TABLE VI.

GROWTH OF POPULATION OF LONDON, 1801-1881.

Date.	Population.	Per Cent. Decennial Increase.
1801	864,035	
1821	1,227,590	19.2
1841	1,872,365	23.5
1851	2,362,236	26.2
1861	2,803,989	18.7
1871	3,254,260	16.4
1881	3,814,571	17.2
Av. 1821-81		21.5

TABLE VII.

GROWTH OF THE TOTAL POPULATION AND CITY POPULATION OF THE UNITED STATES.

	Total Population.		City Population in Cities of 8,000 Inhabitants and over.		
	Actual.	Per cent. Incr.	Per cent. of Total Popula'n.	Increase in p.c. City Popula'n.	Total City Popula'n.
1790	3,929,000	——	3.3	——	131,030
1800	5 308,000	35.1	3.9	0.6	211,000
1810	7 280,000	36.4	4.9	1.0	357,000
1820	9,614 000	33.1	4.9	0.0	475,000
1830	12,866,000	33.5	6.7	1.8	865,000
1840	17,069,000	32.7	8.5	1.8	1,455,000
1850	23,192 000	35.9	12.5	4 0	2,898 000
1860	31,443,000	35.6	16.1	3.6	5,072,000
1870	38,558,000	22.6	20.9	4.8	8,072 000
1880	50,156 000	30.1	22.5	1.6	11,319,000

Average, 32.7 per cent.

ESTIMATED FUTURE GROWTH OF POPULATION.

1890	64,779,000	29.16	25.0	2.5	16,195,000
1900	83,664,000	"	26.0	1.0	21,752,000
1910	108,057,000	"	27.0	"	29,175,000
1920	139,650,000	"	28.0	"	39,102,000
1930	180 248,000	"	29.0	"	47,271,000
1940	232,798,000	"	30.0	"	69,839,000
1950	300,674,000	"	31.0	"	93,087,000

At an estimated annual growth of only 25.89 per cent. the population in 1950 will still be:

1950	251,374,000	——	31.0	——	77,925,000

A part of the break in growth of population shown in 1870 is, of course, due to the war, but a part of it is known to be due to imperfections in the census, especially in the country districts. To this latter cause is also largely due the apparent irregularities in the growth of city population shown in the same and following census.

TABLE VIII.

RATIO OF URBAN TO TOTAL POPULATION IN ENGLAND AND WALES AT DECENNIAL PERIODS.

Year.	Total Population. 1 = 1,000	Urb. Population. 1 = 1,000	Percentage. Urb. of Total.	Percentage. Increase in do.
1851	17,928	9,156	51.0	3.5
1861	20,066	10,933	54.5	2.3
1871	22,713	12,911	56.8	2.8
1881	25,968	15,445	59.6	

Average of Great Britain and Ireland..... 39. per cent.
" " France. ..... 18. " "
" " Germany. ..... 16. " "

POPULATION OF LARGE CITIES OF ENGLAND AND WALES

	1881	1861	1841	1821	1801	Per cent of total population.
London.....	3,815	2 804	1.848	1.379	.959	14.7
Five cities now over 250,000 inhab.	2.096	1.490	.975	.518	.339	8.1
Six cities now between 100,000 and 250,000.	.986	.628	.430	.263	.173	3.8

PER CENT. OF DECENNIAL GROWTH.

					Average.
London.....	16.6	20.0	18.9	19.9	18.8
Cities of 250,000.....	18.6	23.6	37.2	23.6	25.6
Cities under 250,000	25.3	20.9	27.9	38.3	24.3

TABLE IX.

INCREASE IN THE VALUATION PER HEAD OF POPULATION.

	1860	1880	Increase.
New England States,....	$610	$1,235	102.5 per cent.
Middle "	525	1,430	172.2 "
Southern "	595	299	(49.7) "
Western & Pacific "	450	850	88.9 "
	$615	$940	(52.9 per cent.)

NOTE. In considering this table, it is to be remembered:

1. It represents simply wealth per head of population, and thus represents not the growth of total wealth, but simply how much faster wealth increases than population.

2. The apparently slow growth of wealth per head in the West is apparent only, and solely due to the constant influx of vast numbers of poor but productive immigrants.

3. The apparent decrease of wealth in the South is purely fictitious, and results from the transfer of 4,000,000 or more negroes from the numerator of the fraction, where in 1860 they officiated as chattel property, into the denominator of the fraction in 1880, where they now serve merely to swell the population by so many impecunious units, thus producing an apparent decrease of wealth where, in reality, there had been a considerable increase even in 1880, an increase which is now progressing at a far more rapid rate.

4. This error of fact in the South vitiates the average for the whole United States, which to fairly show the facts, should show an increase of 80 to 90 per cent in wealth per head in addition to the increase of about 60 per cent. in the populat on, equivalent to about tripling the total wealth in the 20 years which include the war.

PERSONAL.

OTTO GRUNINGER, C. E., died in this city April 24, at the age of 41. He was the agent in this country for the Abt rack-rail system of railway for heavy grades, and was one of the best informed men in the world on the theory and practice of rack and inclined railways. Mr. GRUNINGER came to this country in 1869 at the request of Mr. RIGGENBACH, the promoter of the Rigi Railway, in Switzerland, to examine the Mount Washington Railway in New Hampshire. He made a very careful and complete report, embracing every detail of construction, and the Rigi Railway was built practically in accordance with the information given in this report. Later he became interested in the improved form of rack, invented by Mr. ABT, and finally became associated with that gentleman. Mr. GRUNINGER was a man of fine qualifications in both civil and mechanical engineering, and was of a genial though reserved social character. His death is a loss to the profession, and he leaves many friends who will regret him.

Col. CARY A. WILSON has been appointed Chief Engineer of the East Tennessee, Virginia & Georgia system. He will have headquarters in New York.

FRANK A. SAWYER, Superintendent of the Maine Consolidated Electric Light Co., of Portland Me., has resigned.

HORACE T. ROCKWELL, Chairman of the Water Board, Boston, Mass., has resigned his position.

L. F. LOREE, Engineer of Maintenance of Way, Pennsylvania R. R., at Logansport, Ind., has been appointed to a similar position on the Cleveland & Pittsburg R. R.

CHARLES S. CHURCHILL has been appointed Chief Engineer of the extension of the Norfolk & Western R. R. from Elkton, W. Va., to Ironton, O., about 200 miles.

WM. SIBLEY, General Superintendent of the Cincinnati & Southeastern R. R., has resigned, and the Receiver has assumed his duties.

H. BISSELL has been appointed Chief Engineer of the Boston & Maine R. R., with office at Boston, Mass. The office of Master of Maintenance of Way of the Eastern and Northern divisions is abolished.

CORRESPONDENCE.

Copying Tracings by the Davy Process.

Office of Borough Engineer.
STAMFORD, Conn., March 29, 1888.

EDITOR ENGINEERING NEWS:

Can you give the details of the "Davy Process" for copying tracings? I am told that by this process, we will obtain black lines on a white ground, but unfortunately we were not furnished the formula. Can you help us to it.

Respecfully yours,
W. B. PIERCE.

[The fullest description of the various processes for copying tracings which we have anywhere been able to find is contained in ENGINEERING NEWS of November 27, 1886, a reprint of a paper by BENJAMIN HOWARD THWAITE before the Institution of Civil Engineers. Of the 12 processes described, 10 produce dark lines on a white ground. The "Davy" process to which our correspondent refers is not described, or at least not under that name, and we are unable to state what the process is. Perhaps some of our readers can enlighten Mr. PIERCE, or if they have experimented with the various processes described in Mr. THWAITE's paper, can state which gives the best results, in practical use. Messrs. KEUFFEL & ESSER, of this city, have an excellent process—the formula for which we understand is kept religiously secret—for obtaining black prints on a white ground, and will make copies by it at reasonable rates. A process has been in use for some years in the largest draughting office in the country, that of the Baldwin Locomotive Works, which gives dark brown lines on a white ground, and is fairly satisfactory in results and ease of manipulation. We are informed, however, that this process is patented. In this connection it seems pertinent to call attention to the great improvements and reductions in cost which have taken place within the past few years in the photographic reproduction of drawings ready for printing. Of course the expense of the process is still considerable compared with such methods as the blue process; but in cases where a large number of copies is desired of moderate size drawings, unless it is a very inexpensive boy who makes the prints, the cost of making and printing a cut will easily bear comparison with the blue process now so universally used.—ED. ENG. NEWS.]

Long Switch Ties vs. Short.

Richmond & Danville R. R. Co.
GREENSBORO, N. C., April 3, 1888.

EDITOR ENGINEERING NEWS:

In the description of the "Standard Point Switch of the Boston & Albany Railroad" on page 244 of your issue of March 31, it is stated that "a feature especially worthy of note is the discarding of the usual long switch ties and the use in their place of ordinary ties, staggered."

I would ask if the use of ordinary cross ties "staggered" is offered as an example of improved practice. And if so, wherein is the improvement as compared with the use of long switch ties in sets?

SWITCH.

[There is room for considerable difference of opinion on this point, and it will be observed that we did not assert it was an "example of improved practice" but only "a feature especially worthy of note". There is, however, much to be said in favor of the use of ordinary ties at switches as elsewhere, as well as against their use. The long ties are expensive; they are difficult to renew; they have for the most part to be renewed in sets; their life is apt to be shorter, and the extra support which the inner rails get because of interlocking is in a measure called for by the extra pounding they get because of the frog and the greater number of wheels which pass over them. On the other hand, the long ties make a much neater looking job, and there are other evident arguments in favor of them to account for their almost universal use. We cannot undertake to decide the question, and if any one has actual records of comparative experience we shall be glad to present them. All we say is that the use of the ordinary ties at switches cannot at the worst be unqualifiedly condemned as bad practice, and it may be on the whole the best, at least in certain localities. ED. ENG. NEWS.]

THE number of ships which passed through the Suez canal last year was 3,137; gross tonnage, 8,430,043 tons. Of the 3,137 ships which went through the canal last year, 2,330 ships were English, leaving a balance of only 807 ships carrying flags of other nations. In this balance, France figured for 183; Germany for 159; Italy for 138; Holland for 123; Austria (and Hungary) for 82; Norway for 28; Spain for 26; and Russia for 22. *Only three* American vessels used the canal in 1887. The total of 3,137 ships last year compared with a passage of 3,100 ships in 1886; 3,624 ships in 1885; 3,284 ships in 1884; and 3,307 ships in 1883. The average time occupied by each ship in the canal last year was 34 hrs. 3 min., as compared with 36 hrs., 11 min. in 1886; 43 hrs. in 1885; 41 hrs., 53 min. in 1884; and 48 hrs., 36 min. in 1883. The considerable reduction in time is due to sundry extensions and improvements carried out since 1885, which have considerably facilitated the passage of shipping.

STILL another elevated railroad project is reported from Chicago. J. C. SMITH, of the New York Stock Exchange, is the President of the Company. The right of way has been largely secured, and it is promised that construction will begin as soon as the ordinance allowing its construction is passed by the Board of Aldermen.

The Garvie Improved Excavator.

This new excavator is described in a recent number of *Industries*, and possesses some novel features, especially in the peculiar rudder-like form of the boom or jib as a guide for the excavator buckets.

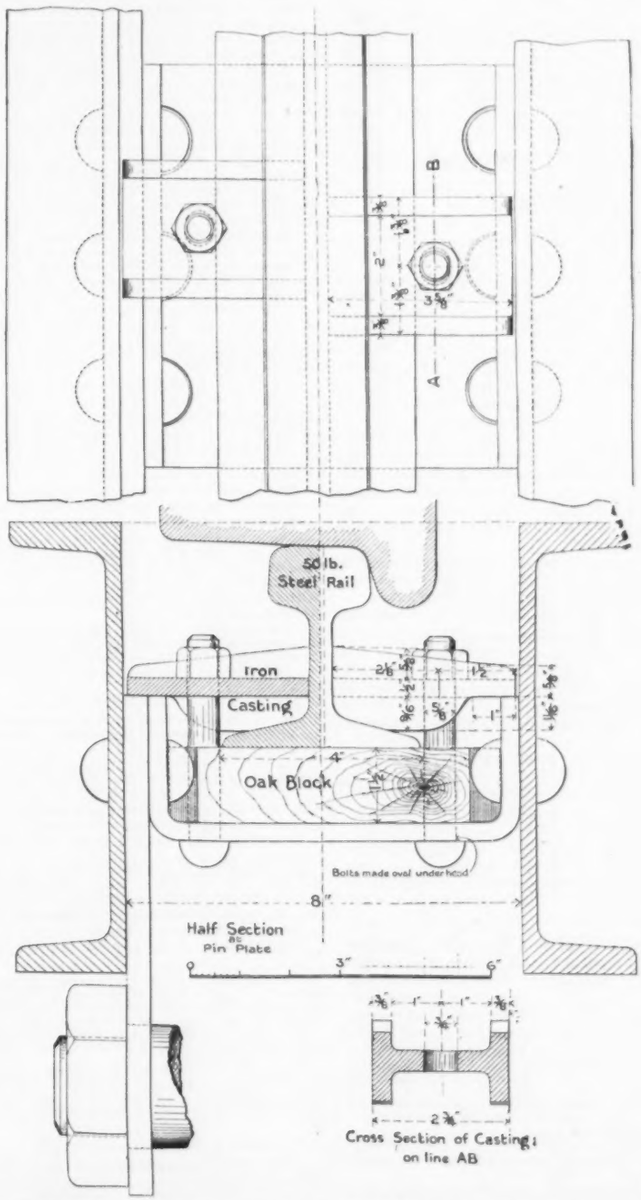
It was designed by Mr. JAS. GARVIE, London, England, who claims as one of its chief merits the ease with which it can be transformed into a simple crane, thus making it an especially desirable machine for light work. The difference between this and other excavators lies in its jib, which may be said to be double, there being an ordinary straight jib, upon which is bolted by strong gusset plates the excavator jib. The latter is formed by curved channel irons attached to the under side of the beams of the ordinary jib. These curved channel irons act as a guide to the excavating bucket. The bucket has four rollers which slide on the curved guide, the lower part of which is horizontal, and the upper part vertical. The bucket travels up and down on the guides.

Triangular frames on each side are jointed to the bucket at their apex, and act as fulcrums in the passage of the bucket from the horizontal to the vertical. The jib is turned to empty the filled bucket, as in any excavator, but the discharge is made by a door in the bottom which is operated with a cord or chain running to the engineer. The great difference between the operation of this and other excavators lies in the motion of the bucket npon the curved jib. Instead of the usual radiating arm, the bucket being lowered in this machine until its lip is upon the bank, then traveling out on the horizontal part of the jib until filled, then up. The curved, or supplementary jib, can be readily attached to the existing jib of any locomotive crane.

AN important traffic contract is reported from Philadelphia, by which the Baltimore & Ohio Co. secures a trackage right over the projected elevated road of the Philadelphia & Reading, terminating at Twelfth and Market Streets. It is stated also that the Reading is considering the extension of its elevated line to the Delaware river.

THE *Halifax Mail* describes a novel sub-marine cable railway proposed by an inventor of that city as a means of connecting Prince Edward's Island and the mainland. There is to be a single track of plate steel, in sections of 20 ft. length, V-shaped, 2½ ft. wide at the top and 1½ ft. in depth, which is to be made hollow and air tight so as to float. From the lower point of the V-shaped track two chains, running out obliquely and attached to heavy granite pillars on the bottoms, will keep the floating track in its proper position at the required depth under water. On the top of the track, and attached to it by wheels running underneath flanges projecting on each side, there will move an air-tight cigar shaped sub-marine car, drawn by an endless chain worked from the shore at each end. This car is to be constructed of steel, 4 ft. wide, 6 ft. high and 30 ft. long, and the main internal compartment will be fitted with seats on each side, and a passage in the center. Each seat will hold one person. At the ends where the car tapers off there are to be air-tight compartments, which will give buoyancy to the car, and from which the passenger compartment will be supplied with fresh air. The car being light at the top and buoyant with compressed air, will retain its upright position and make the passage of 10 miles through the water in about 20 minutes. The time to construct the railway is estimated by the inventor at about two months, and the cost at $50,000. We trust the inventor will be the first passenger to test the machine.

ACCORDING to the official report of the Iron and Steel Association of the United States the total production of pig iron in the nine southern States for the past three years was :—712,835 tons in 1885; 875,179 in 1886; and 929,436 in 1887. For the first two years there was an increase in all of these States, but in 1887 a falling off is shown in Georgia, West Virginia and Kentucky. Alabama has held the lead during the three years, her output in 1887 being 202,762 tons, or nearly one-third of the total production of the nine States. In 1885 Virginia stood next to Alabama in the list, and Tennessee third. In 1887 Tennessee stands second with an output of 250,344 tons. It is noticeable that of the 929,436 tons produced in 1887, coke was used for 730,382 tons, charcoal for 180,581 tons, and anthracite coal for 18,473 tons, the latter being wholly produced in Maryland. But while the States named above have maintained the largest output, the percentage of increase for the 24 months ending Jan. 1, 1888, has been as follows :—Texas, 137, Maryland, 116, and North Carolina, 103 per cent. Virginia is at the bottom of the list with but 7 per cent. increase. In 1887 the total production of pig iron in the United States was 7,187,206 tons, the South contributing 12½ per cent. of this. There are now being built in the South 25 additional furnaces, these will soon be completed, and will largely increase the output, if present prospects are reliable.



Inter-State Rapid Transit Railway. Track and Rail Fastenings. ROBERT GILLHAM, Engineer.

Track and Fail Fastenings, Inter-State Rapid Transit Railway.

We continue this week our illustrations of this new road, with a drawing of the track superstructure used. This arrangement is somewhat novel for this style of structure, and is said to give much satisfaction, dispensing entirely with cross-ties and spikes. The omission of cross-ties permits the free passage of light, and the cushioning of the rails on oak blocks greatly diminishes the noise. It would seem as if the two channel-bars, between which the rail is supported, would have been of more service as a guard rail if the rail had been placed relatively lower; but the objection probably was that it would have necessitated the placing of the rivets carrying the iron stirrups too far below the neutral axis of the channel bars. The rail is fastened down to the oak blocks and the stirrups which carry them by bolts and cast washers as shown, the stirrups being introduced 4 ft. 8¾ ins. apart between centers.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—At the regular meeting, April 7, Vice-President JOHN T. BOYD in the chair; 39 members and 1 visitor present: the Secretary presented, for FREDERIC H. ROBINSON, a description of the Electric Street Railway at Wilmington, Del. WM. H. ROBINSON presented an illustrated paper upon "Rope or Cable as a Transmitter of Power." The Secretary presented, for C. A. PRESTON, a description of "The Effect of Gases, etc., from Stacks, upon Iron," illustrated by a drawing of the Charles St. Bridge, over the N. C. Ry. tracks at Union Station, Baltimore, Md., and by a very complete and interesting set of specimens of iron from the bridge. HERBERT BAMBER presented notes upon "Two Experiments with Cement Mortar". HOWARD MURPHY presented a diagram showing the results of Watertown Arsenal tests of the crushing strength of Potomac red sandstone and other

building stones, bricks and brick masonry. The diagram shows the following:

No. of Tests.	Material.	Crushing Strength in lbs. per sq. in.	
		From.	To.
6	Lee, Mass., Marble	20,504	22,900
10	Potomac Red Sandstone	16,625	22,102
2	Conshohocken, Pa., Limestone.	14,090	16,340
2	Hummelstown, Pa., Sandstone.	12,810	13,610
6	Montgomery Co., Pa., Blue Marble	9,590	13,700
3	Philadelphia Pressed Bricks	7,210	9,050
4	Indiana Limestone	7,190	10,630
11	Philadelphia Hard Bricks	5,540	20,830
10	Ohio Sandstone	3,940	16,280
6	Philadelphia Brick Masonry in Cement Mortar	1,600	2,685
6	Philadelphia Brick Masonry in Lime Mortar	799	1,914

He also noted the other qualities of the Potomac red sandstone which are of special value to the engineer in construction—its durability under the action of frost, fire and wear, and its resistance to dampness. EDWARD HURST BROWN mentioned that the reason that the Potomac red sandstone was not more used for architectural purposes was that, while of a beautiful color, owing to its extreme hardness it was very difficult to dress, and also that very often in an apparently perfect stone a flaw would develop in dressing the face which would render it useless for facing stone. He also mentioned having seen at Brentsville, Prince William Co., Va., an old church built of practically the same stone, taken from the neighboring Bristow Quarry, which had stood for over 100 years, exposed to war and the elements, and which showed no sign of defects due to frost or action of the weather.

In consequence of the lateness of the hour, a communication by G.Y.WISNER, C. E., for years connected with the Lake Survey, entitled "The Physical Phenomena of Lake Harbors", was submitted by title. It shows that the progressive movement of sandy spits is attributable to the resultant waves and currents produced by the periodic oscillations of the lake surface, and that the effects are similar to those produced by the flood-tide on the Atlantic coast, as explained by Prof. L. M. HAUPT in his paper on "The Physical Phenomena of Harbor Entrances."

HOWARD MURPHY,
Secretary and Treasurer

Engineers' Society of Western Pennsylvania.—A regular meeting of the society was held April 17, attended by 56 members and 4 visitors. GEO. H. BARBOUR and LEWIS B. FULTON were elected members. PHINEAS BARNES read an interesting paper on "Aluminum", the discussion of which was participated in by A. E. HUNT, WM. METCALF, T. P. ROBERTS, I. A. BRASHEAR and several others.

Engineers' Club of Kansas City.—An adjourned meeting was held April 16, eleven members and 2 visitors present. The resignation of G. S. STEALEY was accepted. The discussion on Prof. WADDELL'S paper on bridges was continued, and the following resolutions, presented by O. CHANUTE, were adopted:

1st. That a committee of 3 be appointed by the President to prepare and submit to the Executive Committee a form of memorial to the Legislature of the State together with a draft of a law inaugurating a proper inspection of bridges, and that for this purpose the committee may consult with public spirited counsel.

2d. That the Secretary be instructed to notify other engineering societies and clubs throughout this country of the action taken by the club, and to solicit their coöperation in this movement.

3d. That in case of the appointment of similar committees by other clubs the committee of this club be instructed to confer and coöperate with them in drafting the project for the proposed law and in drawing up general specifications and rules to guide the State inspector.

Mr. CHANUTE mentioned the following means as proposed for effecting the desired reform: 1st. The employment of expert engineers. 2d. The use of legal standards of strength, as was once recommended by the American Society of Civil Engineers. 3d. The formation of a pool of responsible bridge builders, as outlined in Prof. WADDELL'S pamphlet. 4th. State inspection, as now in use in Massachusetts and New York. The latter was generally considered the most feasible. Mr. WYNNE thought expense in the latter case might be avoided by inspecting the existing bridges as opportunity occurs, keeping on hand a force simply sufficient to report on new work. Messrs. CHANUTE, WADDELL and BREITHAUPT were appointed a Committee.

KENNETH ALLEN, *Secretary.*

American Water-Works Association.

(*Continued from page 335*)

THURSDAY MORNING SESSION, APRIL 19TH.

The meeting was called to order by President FANNING at 10.35 A.M., and he announced that Mr. HAGUE who was to have read a paper yesterday afternoon on "Feed Water Heaters and Condensers," was not here at that time, but that he was with us now, and the members would be pleased to hear from him.

Mr. HAGUE said that he owed an apology to the Association in not having prepared a paper as per agreement, but that he had put it off from time to time owing to press of business, until it had got too late, and he was unable to prepare one. He said however, that he would fulfill his promise partially, by making a few remarks.

He said that he could speak from actual experience, that the use of condensers in reservoir services and on engines of large size, was beyond a question a good thing; and that the great reduction in the cost of producing, as it takes considerable less fuel where condensers are used, would be an item well worthy the attention of parties having charge of such plants. He did not think the saving would be as great in using them on smaller plants, but in some instances said he thought they would be a good thing. The question of buying such machinery, often looks to be very great and sometimes unnecessary to some men, but when we get results that show so plainly the saving effected by the use of condensers, there should no longer be any hesitancy on the part of those having charge of large plants in putting them in use. The question of securing the very best machinery, which will work the most satisfactorily and economically, is well worthy the attention of all water-works superintendents and engineers.

SECRETARY.—Do I understand that Mr. HAGUE would not recommend the use of a condenser for a plant of less than 2,000,000 galls. capacity. We will estimate an engine with dynamic pressure of from 60 to 75 lbs., speed 90 to 100 ft., with a steam pressure of 75 or 80 lbs.—compounds. In such a case would it be economy to use a condenser?

Mr. HAGUE.—In reservoir services certainly.

In reply to Mr. DECKER'S further inquiry, as to whether he thought there would be any economy in using condensers where a pump was pumping alkaline water which produces scaling rapidly, whether the action on the water would be such as to effect a saving to any very great extent; Mr. HAGUE said that in some cases he would recommend its use, though not always.

Mr. DUNHAM.—Where steam is thrown into the atmosphere there exists a disagreeable noise, which always attracts more or less observation. Is there no simpler way of stopping this than by the use of a condenser?

Mr. HAGUE.—I do not think there is.

Mr. GERECKE stated that the question of surface condensers is already being taken into consideration in a very general way. It is used on many steamboats to a considerable extent at this time, especially on the Atlantic steamers. There is another important point in reference to this question. The exhaust injectors are used so that you need not use any high pressure system through the engines.

MEMBER.—Can we use these with a compound engine?

Mr. HAGUE.—I could not tell. In the Eastern States they are doing this. In reference to Mr. GERECKE'S remarks I would say I am familiar with the Exhaust Injector and, as he says, it is in use largerly in the Eastern States.

Mr. DUNHAM.—I beg to offer the following resolutions:

That the thanks of the Association are due and hereby tendered to JOHN WHITELAW, Esq., and to the Engineers Club of which he is President, for the excellent paper read by him at the City Hall, last evening, for diagrams presented and the exhibition of the working model to the club, and the information given in response to questions from our members.

Also, to W. A. MADISON, Esq., Secretary of the Cleveland Water-Works Board, for his paper relating to water-works accounts, also presented at the same meeting, which was of great interest to the members of our Association.

The vote was unanimous in favor.

I also have another pleasant duty in presenting, in behalf of the ladies, the following resolution:

We, the ladies and guests of the American Water-Works Association, hereby express our pleasure in a vote of thanks to C. E. BURKE, Esq., for the courtesy extended to us in showing the sights, manufacturing interests, etc., of Cleveland.

Signed: Miss BYLE, Mrs. RICHARD HOLME, Jr., Mrs. A. N. DENMAN, Mrs. B. F. STEPHENS, Mrs. WM. BYLE, Mrs. ALIDA LATTIMORE, Mrs. A. W. MORGAN, Mrs. REUBEN GETZ, Mrs. HERMANY and Mrs. MORTON.

Vote of thanks was also adopted.

PRESIDENT.—The next paper on our regular programme is "Recent Filtration Practice in India", by Mr. S. Tomlinson. Mr. Tomlinson not being present, portions of the paper were read by the Secretary, after which the President said, there are several large fine drawings which you can examine at your convenience. The sketch on the map on the side of the wall gives a good general idea of the system.

Mr. WILLIAM G. RICHARDS of Atlanta read a paper on "Practical Results in Mechanical Filtration". Mr. RICHARDS told his experience in building the twelve filters at Atlanta. The water flows from the reservoir directly to the filters. The average height of the water in the reservoir is on a level with the bottom of the filters. Gate valves are attached to the inlet and outlet pipes so that the water can be regulated. These valves are opened by an ingenious arrangement of hydraulic heads. After passing into the clear water basin small objects can be distinguished in the basin at the distance below the surface of 20 ft. The cost of the filters, including house and clear water basin, was only about $52,000. He spoke of the satisfactory results obtained and said that 2,000,000 galls. were filtered daily at a cost of about $10. [This filtering apparatus is illustrated this week in our advertising pages. ED ENG. NEWS.]

Mr. GARDNER said that this was doubtless a paper that all would like to ask Mr. Richards questions about, and expressed himself as thinking it would be perfectly legitimate to ask Mr. Richards any questions they might desire in regard to the question of water purification.

MEMBER—Is the full head of 19 ins. used on your filter to force the water through?

Mr. RICHARDS—Yes Sir—the full head of the reservoir.

MEMBER—In regard to the color of the water in the reservoirs after it has been through the filter: what is it?

Mr. RICHARDS—It is perfectly clear.

Mr. STEPHENS.—I would like to ask for what period these experiments have been tried. The question of natural law would naturally follow in determining results, as to whether the materials held in suspension are greater in summer than in winter—so that the experiment would be more satisfactory if tried during a whole season, or especially during the season of vegetable growth?

ANSWER.—In the summer when we have our warm rains there is the greatest amount of suspended matter to contend with. Mr. RICHARDS also stated that they had passed through the worst season. It would seem therefore that they had been put to good test.

Mr. HOLME.—Does your impounding reservoir collect moss, etc., on the surface?

Mr. RICHARDS.—No Sir.

Mr. BILLINGS.—I would like to ask how much water it takes to return filtered, 1,000,000 galls. of water.

Mr. RICHARDS.—I cannot answer positively. We pay but little attention to such points.

MEMBER.—What is the capacity of the clear water reservoir, that is the reservoir that holds water after it passes through the filter?

Mr. RICHARDS.—300,000 galls.

Mr. HOLME.—Do you ever notice any growths of any kind in that reservoir?

Mr. RICHARDS.—There will be no growth if it is thoroughly cleansed each season?

PRESIDENT.—Do you have ice on your basins in winter?

Mr. RICHARDS.—No sir. We have but very little ice, and that is so thin that it never causes any trouble. The water in the clear water basin does not remain quiet long enough to allow ice to form.

Mr. DUNHAM.—I would like to ask if they had an analysis of the water prior to filtration so as to make a comparison after it has been filtered.

Mr. RICHARDS.—They did. But I cannot furnish that analysis, as it is in the hands of the State Board of Health.

PRESIDENT.—Will Mr. RICHARDS add that to his paper, so it will go in with the report of the proceedings and Secretary's records?

Mr. RICHARDS.—I will.

MEMBER.—I would like to know if he remembers anything about the result of the comparison?

Mr. RICHARDS.—No sir.

MEMBER.—It would be of interest to quite a number.

Mr. JUDSON.—With reference to the copper disks mentioned in Mr. RICHARD'S paper, I would like to ask what they are?

Mr. RICHARDS.—These copper disks, are of a saucer shape, and are so placed as to prevent any sediment or other matter passing out of the filter. They are saucers in which a small quantity of salt is placed, so that the bore is on the outside. These prevent any sand or other matter in the filter from passing out.

PRESIDENT.—Next in regular order is a paper by Mr. HARRISON, on "The Use of Liquid and Gaseous Fuels." As Mr. HARRISON is not present, perhaps Mr. GERECKE, who has had some experience in that matter, can give us some information on that point. Mr. WHITELAW'S information given us last night was interesting and valuable, in a financial way as well as professionally.

Mr. GERECKE.—We tried an experiment of using oil as a fuel in Chicago last winter for six months. By careful calculations and accurate accounts, it cost $885.00 more to use oil for six months than it did coal; or reducing it to the hour, it cost just twenty-two cents per hour more than coal. He also said that the gentlemen of whom the oil was purchased, and through whose influence the experiment was tried, reduced his bill so that it would be the same as coal. The Water Works did not lose anything practically. It was, however, shown that oil as a fuel is not as cheap as coal, both by Mr. WHITELAW and Mr. GERECKE.

In reply to an inquiry with reference to the wear and tear in using oil as a fuel as compared with of coal, Mr. GERECKE said that no particular difference was noticeable; though we did not try it long enough to decide positively on such a point. The opinion was expressed that the use of oil would be less injurious than that of coal. Many statistics which were asked for, such as the number of gallons of water that can be produced by a ton of coal compared with a barrel of oil, etc., Mr. GERECKE was unable to give, but he said they were all to appear in his report; and in reply to a request, he is to send these figures to the Association. In reply to an inquiry as to whether the use of oil produced an objectionable odor or not, he said it did not, and that outside of the building you could not smell it at all—though, of course, inside it was noticeable.

In reply to Mr. STEPHENS' inquiry as to whether he would prefer the use of it over that of coal at the same price, Mr. GERECKE said he could not tell.

Mr. STEPHENS said, he was about to apply it to a boiler. Mr. GARDNER requested that the subject be assigned to some member who would bring a paper on it for the next session.

A paper by Mr. TUBBS, of Rochester, on "Approximate Determination of the Rental Values of Fire Hydrants," was then read. [This paper will be published next week.]

THURSDAY AFTERNOON SESSION.

The following officers were elected for the ensuing year:

A. N. DENMAN, President, Des Moines, Iowa; J. M. DIVEN, Vice President, Elmira, N. Y.; J. H. DECKER, Secretary and Treasurer, Hannibal, Mo.

Finance Committee.—FRANK W. HOLLY, Lockport, N. Y.; F. L. FULLER, Boston, Mass.; THOMAS N. HOOPER, Davenport, Ia.

The next meeting will be held in Louisville, Ky., beginning on the third Tuesday in April, 1889. A vote of thanks to the President was passed, and the Convention adjourned. The following is a list of members in attendance:

ACTIVE.—Chas. P. Allen, Engineer of Water-Works, Denver, Colo.; H. W. Ayres, C. E. waterworks, Hartford, Conn.; S. E. Babcock, C. E., waterworks, Little Falls, N. Y.; Calvin S. Brown, with National Meter Company, New York; D. M. Clark; Edwin Darling, superintendent, Pawtucket, R. I.; J. H. Decker, engineer and superintendent water company, Hannibal, Mo.; A. N. Denman, secretary water company, Des Moines, Ia.; J. M. Diven, sec. and, treas. water company, Elmira, N. Y.; H. F. Dunham, consulting engineer, Cleveland, O.; J. T. Fanning; civil and consulting engineer, Minneapolis, Minn.; E. W. Frost, superintendent, Colorado Springs, Col.; L. H. Gardner, superintendent water company, New Orleans, La.; C. A. Hague, M. E. with Knowles Steam Pump Co. W. S. Hamilton, superintendent, Youngstown, O.; J. W. Henion, superintendent, Minneapolis, Minn.; Frank W. Holly, M. E., Lockport, N. Y.; Richard Holme, Cashier Denver Water Co. Thomas N. Hooper, chief engineer water-works, Davenport, Ia.; George Hornung, C. E., Newport, Ky.; A. J. Jones, superintendent, New Brunswick, N. J.; Wm. Molis, superintendent, Muscatine, Ia.; B. R. Morton, C. E., superintendent, Newport, Ky.; Charles N. Priddy, superintendent, Leadville, Col.; W. G. Richards, superintendent, Atlanta, Ga.; Wm. Ryle, superintendent, Paterson, N. J.; B. F. Stephens, Flatbush, L. I., N. Y.; John W. Troy, superintendent, Pierre, Dak.; J. Nelson Tubbs, chief engineer water-works, Rochester, N. Y.; Timothy Woodruff, Bridgeton, N. J.; F. L. Fuller, C. E., Boston, Mass.; R. M. Gow, superintendent, Medford, Mass.; H. E. Keeler, director of water company of Charleston, Ill.; E. H. Phipps, superintendent, West Haven, Conn.

The following new members were elected: ACTIVE—Silas W. Harris, engineer water-works, Racine, Wis.; Joseph A. Bond, chief engineer, Wilmington, Del.; F. W. Gerecke, chief engineer water-works, Chicago; Ill.; Eugene J. Snow, C. E., Brooklyn, N. Y.; John T. Lakin, superintendent, Rockford, Ill.; J. S. Walker, engineer water-works, Birmingham, Ala.; Thomas J. Neville, water registrar, Rochester, N. Y.; John Young, hydraulic engineer, Geneseo, N. Y.; Robert B. L. Bennett, St. Paul; A. R. Wadsworth, Superintendent, Farmington, Conn.; J. W. Taylor, New Castle, Pa.; Edwin C. Cooke, chief engineer, with Moffett, Hodgkins & Clarke, Tiffin, O.; Charles A. Judson, superintendent, Sandusky, O.; W. F. Harris, Jackson, Tenn.; F. W. Shepperd, New York; J. H. Benzenberg, Milwaukee, Wis.; Eugene J. Lyons, Brooklyn, N. Y.; W. T. Walker, Jackson, Tenn.; Philip Morley, East Liverpool, Ohio.

On the evening of Thursday the usual banquet was given at the Hollenden House. About 80 members, ladies and guests were present. The Mayor of Cleveland responded to the first toast. The party broke up at a late hour. Friday was devoted to sight seeing.

THE EXHIBITS.

In response to the invitation issued in the circular of the Association, a very gratifying and very interesting exhibition of Water-Works Appliances was held. The corridor of the second floor of the hotel, leading to the parlors was given up for the use of the Associate Members who availed themselves of the privilege to occupy every inch of the space. The enterprising host of the Hollenden furnished tables and trestles for the exhibitors' use and the hotel porters lent their assistance in unpacking and packing boxes in lieu of sundry fees. The corridor was at all times crowded and a capital opportunity was afforded for introducing any novelty in machinery to the superintendents, or pushing the trade in already well known goods. The following firms were represented either by members of the firm or by one or more agents, and an unlimited amount of trade literature:

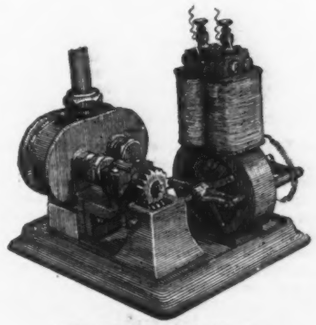
THE CHAPMAN VALVE MANF'G CO. Indian Orchard, Mass., represented by W. R. BILLINGS, late Superintendent of Taunton, Mass. Water-Works: THE LUDLOW VALVE MFG. CO. Troy, N. Y. by MCINTOSH, GOOD and HUNTINGTON, Cleveland, O.: R. D. WOOD & CO., Philadelphia, Pa., exhibiting the Mathew's Hydrant and Eddy Valves, by E. T. PRENTICE: HOLLY MFG. CO. Lockport, N. Y., exhibiting the Gaskill Fire Hydrant, by FRANK W. HOLLY, Assistant Engineer, Lockport, N. Y.: RICHARD BEAUMONT of Kankakee, personally exhibited and explained the latest improvements in his Fire Hydrant: WALTER PAYNE & Co., of Fostoria, O., exhibited the Abel Gate Valve and also their "Crow" or Dry Pipe Tapping Machine: A. & W. S. CARR Co., 65 John St. N. Y., exhibited their Circular Gate Valve: the LORAIN MFG. Co. of Cleveland, O., exhibited the Lorain Hydrant and Street Washer: THE GALVIN BRASS AND IRON WORKS, Detroit, Mich., were well represented by JAS. B. CLOW & SON, General Agents, Chicago, Ills.: FRED ADEE & Co. 90 Beekman St. N. Y., represented by an agent, had a large exhibit of the "Boss" Stop Cock: ROUSE, HILLS & Co. of Cleveland, O., displayed to equal advantage Bingham & Taylor's Extension Shut off Boxes: WALTER S. PAYNE & Co. Fostoria, their Patent Curb Box: FARNAN'S BRASS WORKS, 27 Center St., Cleveland, O., had "something new" in the Farnan Curb Cock: THOS. KELLY & BRO. of Chicago also exhibited samples of Stop and Waste Cocks: T. MOSHLEY & Co. Kansas City, Mo., in the same line were represented by their General Eastern Agent, FRANK M. POTTER, 37 Howard St., Newark, N. J.: H. MUELLER of Decatur, Ills., personally represented the merits of his exhibit of Tapping Machines, Pressure Regulators and Corporation Stop Cocks.

The Cast Iron Pipe interest was represented only by Messrs. R. D. WOOD & Co. of Philadelphia, and the LAKE SHORE FOUNDRY, of Cleveland, O.

The Water Meter trade was most ably represented: the old firm of H. R. Worthington, 145 Broadway, New York, by S. A. WELCH, Esq: the National Meter Co. 252 Broadway, New York, by its genial and enterprising President, John C. Kelley, Esq. and the old established Union Water Meter Co. of Worcester, Mass., by J. C. OTIS: the more recent but very enterprising HERSEY METER Co. of South Boston by Mr. TILDEN: Edson's Recording Gauge from Liberty St., New York was exhibited by Mr. HARRIS, and afterwards sold to the Hollenden, where it was placed in a conspicuous place in the main office for the benefit of the guests' nerves:

The Purification of Water was well illustrated by the enthusiastic Mr. OLIPHANT of the Oliphant Filter Manufacturing Co., 93 Liberty St., New York City: THE JEWELL PURE WATER Co., Chicago, Ills., represented by JAS. B. CLOW & SON, in person of the latter, showed by sample the remarkably cleansing action of their Filter on Chicago river water. This firm also showed a great variety of brass goods, plumber's supplies, and waterworks appliances; their catalogue shows a vast variety of goods handled by them.

HINE & ROBERTSON 45 Cortlandt St., New York, presented the merits of their Grease, Oil and Grit Eliminator: E. H. KELLOGG & Co., 243 South St., New York, were well represented by agents and samples of their unexcelled Anti-Corrosive Cylinder Oils: PEDRICK and AYER of Philadelphia, Pa., exhibited samples of Self Adjusting Cylinder Packing: the COLUMBUS BRASS AND STEAM PIPE WORKS, of Columbus, O., were represented by Mr. Isaac B. Potts, President & Treasurer of the Co. Pumping machinery was most ably represented by Capt. H G. R. TABB of the H. R. WORTHINGTON Co., and by Mr. FRANK W. HOLLY, in the interests of the Holly Manufacturing Co., Lockport, N.Y. It was not exactly feasible, however, for these firms to exhibit the working of the



The Hall Electric Pump.

latest attachments of the celebrated Worthington Duplex, or the Gaskill Horizontal Compound Pumping Engines, except by illustration, which was in fact, most thoroughly done: there was one company, however, which did exhibit a complete pumping engine: the HALL ELECTRIC PUMP Co. of Plainfield, N. J. Their exhibit was truly "a thing of beauty" (and of life) and we feel sure will prove "a joy forever" to any purchaser. The Hall Electric Pump is a recent application of the Electric Motor to pumping purposes. The inventor A. E. HALL, is already well known through his invention of the Duplex Pump which bears his name. He exhibited his Electric Pump at the Convention, and there was only one opinion in regard to it expressed by all who witnessed its inimitable action: that it is the best thing in pumps ever seen. The owner of the Hollenden House ordered one to be placed in the Sixth story of the hotel to supply the two floors above with water. The pump is entirely automatic: when water is drawn the pump is set in motion by the act of turning on the water: when the tank is again filled the pump stops. The only attention necessary is to give it a supply of oil once in a week or two. The No. 1 Pump exhibited has a capacity of 150 galls. per hour, with 25 ft. suction, and to raise the water 50 ft. above itself. It was driven by the current taken from the nearest light, through an ⅓ H. P. C. & C. motor.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Zanesville, Newcomerstown & Cleveland.—Grading has begun on this line at Zanesville, Ohio.

Cleveland & Canton.—A preliminary survey has been made for the Zanesville extension and a second line is now being run.

Toledo, Saginaw & Mackinaw.—Tracklaying has begun on this line between Durand, Mich., and East Saginaw, 50 miles. Surveys are in progress from East Saginaw toward Bay City.

Old Colony.—An extensive system of interlocking switches and signals has just been completed at the junction of the main line with the Providence division and the northern division by the Union Switch & Signal Co.

New Projects and Surveys.

Raritan River.—This New Jersey railroad is to run from South Amboy to Bound Brook. E. H. Ripley is President, and E. W. Harrison, Fuller Building, Jersey City, is Chief Engineer.

Kokomo Belt.—A company has been formed at Kokomo, Ind., to build a belt railroad.

New Projects and Surveys.

Helena, Tupelo & Decatur.—This company has been organized at Tupelo, Miss. J. L. Finlay, is President and S. C. Medford, Secretary.

Montgomery & Maplesville.—The survey of this Alabama line has been completed, and the distance is found to be about 50 miles.

Hampton & Old Point.—At a meeting of the incorporators of this company at Hampton, Va., April 20, it was voted to build the line as soon as right of way could be secured.

Louisville & Nashville.—Thirty two miles of track of the Cumberland Valley Branch between Corbin and Pinesville, Ky., will be turned over to the operating department on May 1. Work on the extension from Pinesville to Cumberland Gap, 15 miles, is not yet let.

Cape Fear & Yadkin Valley.—The first preliminary survey for the Wilmington extension, 85 miles in length, has been completed, and another route is to be surveyed at once.

East Tennessee, Virginia & Georgia.—Two preliminary surveys have been made from Sand Hill, Ga., to Jacksonville, Fla., and a third line is to be run from Hazelhurst to Jacksonville. The second or third line will be the one adopted.

Baltimore & Ohio.—Grading is in progress on the branch from Alpine to Berkeley Springs, W. Va.

Richmond & West Point Terminal.—The election of John A. Inman to succeed Alfred Sully as President of this company is a grand stroke on the part of the present directorate and it is thought hardly possible that the opposition faction can now win.

THE NORTHWEST.

Existing Roads.

Duluth & Iron Range.—It is reported that this company contemplates extensive improvements to its Duluth terminals and an extension from its present terminus to Rainy lake.

St. Louis, Alton & Springfield.—About four miles have been graded on the Alton extension.

Wabash.—The Streator division, 31 miles in length, has got badly out of repair and has been sharply criticised by the State Railway Commissioners. Work is to begin at once on the thorough reconstruction of the line including new iron bridges and steel rails, ballasting, etc.

Winnipeg & Hudson Bay.—A rumor from Winnipeg is to the effect that the Dominion Government has decided to grant a cash subsidy to the company for the extension of their road.

New Projects and Surveys.

Duluth, Glencoe & Southwestern.—Incorporated in Minnesota by A. H. Reed, E. A. Child, G. K. Gilbert and H. Wadsworth, of Glencoe, and William Vanderbilt, of New York City, to build a railroad from Duluth *via* Glencoe to the southern or western State line.

St. Ignace, Sault Ste. Marie & Northern.—The preliminary survey is in progress on this road in the North Michigan peninsula from St. Ignace to Sault Ste. Marie. William Chandler, of the latter place, is President.

THE SOUTHWEST.

Existing Roads.

Little Rock Bridge & Terminal Co.—

Room 201, Allis Building.

LITTLE ROCK, Ark., April 20, 1888.

EDITOR ENGINEERING NEWS:

This company has been organized for the purpose of building a bridge across the Arkansas River at this place with tracks connecting with different lines now built or hereafter to be constructed. Probable length of tracks about 4 miles. The enterprise is in the interest of and is backed by the St. Louis, Arkansas & Texas Railroad Company. Judge J. W. PHILLIPS, Equitable Building, St. Louis, Mo., is President.

JNO. C. ENGLAND, *Sec. & Treas.*

Kansas City & Pacific.—The Kansas City Board of Trade is considering the question of aid to this company in securing for it terminals at Kansas City. The extension to Paola will be rapidly pushed through and a bill is now before Congress granting the company right of way through Indian Territory.

Kansas City, Wyandotte & Northwestern.—This company is marketing an issue of $2,000,000 five per cent. first mortgage bonds in England.

Kansas City, Fort Scott & Gulf.—At the recent meeting the consolidation of the allied lines of the system under the name of the Kansas City, Fort Scott & Memphis was agreed on.

New Projects and Surveys.

Omaha, Dodge City & Southern.—

DODGE CITY, Kan., April 20, 1888.

EDITOR ENGINEERING NEWS:

Our line is projected to run from Omaha, Neb., *via* Chester, Mankato, Kan., Hays City, Jetmore, Dodge City and Montezuma, passing out of the State at the southeast corner of Morton Co. A branch from Montezuma is now building to Trinidad, Col.; end of main line will be at El Paso. The line is to be placed under survey immediately. Capital for construction is secured and contracts will be let July 1, 1888. C. E. GALLAGHER, of Dodge City, is Vice President and Chief Engineer. The Dodge City, Montezuma & Trinidad is to be 245 miles in length and 27 miles of grading and bridging are now under contract. A. T. SOULE, of Rochester, N.Y., is President and General Manager. The Kingman, Pratt & Western, supposed to be in the St. L. & S. F. interest, is now building from Ford Co. line to Dodge City. T. M. HOOVER, *Pres. O., D. Cy. & So. R. R.*

Aurora.—It is reported that a movement is on foot at Aurora, Mo., for securing the construction of a railroad from Ash Grove, Mo., *via* Aurora to Eureka Springs, Ark.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Calabasas, Tucson & Northwest.—Additional particulars sent us in reference to this Arizona road noted last week, are that surveys have been completed from Calabasas to Tucson, 60 miles, under direction of W. S. EDWARDS, Chief Engineer. Bonds have been issued for $17,000 per mile, and Belden & McTighe, of New York City, have taken the whole contract for construction. CHAS. C. DODGE, of New York City, is President, and C. P. SYKES, Calabasas, Arizona, is Vice-President and General Manager.

Oregon & Washington Territory.—The tracklaying has been completed on the branch to Centerville, Ore.

Oregon Ry. & Navigation Company.—Contracts have been let for the construction of the Eureka Flat and Heppner extensions, 38½ and 45 miles in length, to Kilpatrick Bros. & Collins, of Beatrice, Neb. Two corps of engineers are at work on surveys for lines to Spokane Falls and to the Cœur d' Alene mining regions, and it is quite likely that the lines will be constructed. Bills are before Congress authorizing the construction of railroad bridges by the company across the Snake and the Clearwater rivers.

San Francisco & North Pacific.—It is expected that 13 miles of the Cloverdale and Ukiah extension will be in operation by June 1. Ukiah will probably be the terminus of the line for some time, but a survey has already been made to Eureka, and the line will doubtless be pushed to that point eventually.

Chicago, Burlington & Quincy.—The Denver *Republican* says, "The Burlington has closed the engineer's office in this city, which was maintained for the purpose of securing a feasible route across the mountains to Western Colorado. This means that during this year nothing will be done on the Burlington's western line. But there is very little doubt that the line will be built in the course of a few years. The company has spent too much money upon it to abandon it altogether."

Denver & Rio Grande.—A special stockholders' meeting is called for May 22 to vote on the contract with the Rock Island Co., for joint use of the tracks from Denver to South Pueblo. Since Jan. 12, 1886, over $6,300,000 has been expended on improvements, of which $683,621 is yet to be raised. It is necessary to lay a third rail or change to standard gauge about 500 miles of road and the directors ask authority to issue a mortgage for $3,000,000 to raise the funds now required.

Union Pacific.—The annual report just issued makes the following thoroughly gratifying showing:

	1886.	1887.	Increase.
Gross earnings,	$17,806,132	$19,546,088	$1,749,956
Operating expenses,	10,283,425	10,434,292	150,777
Net earnings,	7,522,707	9,111,886	1,589,179

The above is for the Union Pacific proper. The showing for the whole system including branches and auxiliary lines, is of the same sort. It appears that the balance applicable to dividends on Dec. 31, 1887, was $3,169,729.16, or 5.20 per cent. upon the capital stock of the Union Pacific Railway Co. During the year the company spent $5,580,079.59 in the construction of new branches or extensions, and $1,238,714.65 was spent for new construction and equipment for the company's main lines. The report shows decreases of consequence in the company's funded and floating debt. At the end of 1886 the funded debt aggregated $148,870,393 and the floating debt was $1,351,190, a total of $147,519,203. At the end of 1887 the funded debt was $147,590,911 and the floating debt was $401,689, a total of $147,189,222. Since 1884 the funded debt has been decreased $955,549, and the floating debt has been cut down $7,301,867, a total decrease in the debt of $8,257,416. Meantime the mileage has increased 351 miles, making a decrease per mile in the company's debt of $4,320.

New Projects and Surveys.

Bellingham Bay Ry. & Navigation Co.—

SEATTLE, WASHINGTON TERRITORY, April 17, 1888.

EDITOR ENGINEERING NEWS:

The Bellingham Bay Railway is to run from Seattle to Whatcom, 95 miles, thence northeast toward Hope, 18 miles, and northwest toward New Westminster, B. C., to the International boundary, 20 miles. The line has been surveyed from Seattle to Hope, and the right of way is partially secured. Negotiations are pending for securing capital and a part is already assured. Contracts for construction will be let this spring, about 22 miles of the line to be completed and opened for traffic by fall. The work is light. Maximum grades are 90 ft. per mile, but half the line is under 20 ft. and only 3 miles are over 50 ft. There will be one 1,750 ft. bridge with draw span. J. Tilton Sheets is Chief Engineer. Eugene Canfield, *President.*

Olympia, Gray's Harbor & Baker's Bay.—Incorporated by A. A. Phillips, A. H. Chambers, J. R. Hayden, and others, of Olympia, W. T., to build a railroad to Baker's Bay.

Contracting.

Water-Works Contracts.—Greensburg, Ind.—The City Council took final action April 20 in reference to the water-works contract. The following proposals were received: Samuel R. Bullock & Co., of New York City, 7½ miles of mains, 100 hydrants, direct pressure system; $8,500 per annum on 20 years franchise. Comegys & Lewis, of New York City, 8 miles of mains, 80 hydrants, stand-pipe 15×125 ft.; $4,000. Jesse W. Starr, of Philadelphia, Pa., 8 miles of mains, 85 hydrants; $4,000. The contract was awarded to Samuel R. Bullock & Co.

Dalton, Ga.—The contract for the construction of the water-works has been awarded to the Union Iron Works Co., of Chattanooga, Tenn., for $30,000. The works to be completed by July 1.

Catoosa Springs, Ga.—The contract for the new water-works has been awarded to the Union Iron Works Co., of Chattanooga, Tenn.

Tecumseh, Neb.—The contract for a complete system of water-works has been awarded to Ben S. Clark, of Holdrege, Neb., for $20,900. P. A. Brundage, City Clerk.

Clarksburg Water-Works.—The Water Commissioners, Clarksburg, W. Va., will receive proposals for the construction of the water-works till May 15. The work is as follows: 617 net tons of 4 to 12-in. cast-iron pipe; 24,000 lbs. of specials; 29 fire hydrants with 6-in. bells and 5-in. stand-pipes; 22 fire hydrants with 4-in. bells and 4-in. stand-pipes; 34 stop valves, 4 to 10 ins.; one 10-in. check valve; 33 cast-iron stop boxes. Laying pipe, setting hydrants, etc. Two compound, non-condensing, duplex, direct acting pumps, with a daily capacity of 500,000 galls. at 90 ft. per min. piston speed, against a water pressure of 150 lbs. and with a steam pressure of 90 lbs.; also 2 return tubular boilers with appurtenances. Brick pumping station and chimney. Two steel reservoir tanks of 280,000 galls. capacity each. Masonry influent well. The Consulting Engineer is John W. Hill, Glenn Building, Cincinnati, O.

Artesian Wells.—The following proposals for boring artesian wells have been received by G. H. COLE, City Clerk, Toledo, O.: Corner Germania & Ewing Sts., Frank Hake, $2.85 per ft. in rock, $1 in earth; Marsh & Lewis, $2 in rock and earth; W. O. Ernsberger, $1.90 in rock and earth. Collingwood and Central Ave., T. T. Munger, $3.50 per ft. in rock, $1.50 in earth; Frank Hake, $2.85 and $1; W. O. Ernsberger, $1.90 in rock and earth; Marsh & Lewis, $2 in rock and earth. Ewing and Tecumseh Sts., T. T. Munger, $2.90 in rock, $1.25 in earth; Frank Hake, $2.85, $1; Marsh & Lewis, $2; W. O. Ernsberger, $1.90.

Street Work.—The Board of Public Improvements, St. Louis, Mo., has awarded contracts as follows: Paving with pine wood blocks treated with chloride of zinc; Morgan St.; Henry Ruckert; taking up pavement, preparing roadbed, etc., $5.50 per square of 100 sup. ft.; new 4-in. curbing furnished and set, 90 cts. per lin. ft.; old curbing taken up and reset, 20 cts. per lin. ft.; hydraulic cement concrete, 6 ins. deep, laid complete, $12 per square; laying pavement of pine blocks impregnated with chloride of zinc, $24 per square; maintenance, 50 cts. per square per annum; total, $28,013.——Easton Ave., Allen & Vieths; removing paving, etc., $5.25 and $5.50; new curb, 90 cts.; old curb, 20 cts.; concrete, $10; paving, $26.50; maintenance, 50 cts.; total, $54,883 40.——Clark Ave. and Chestnut St., Fred Skrainka; removing old paving, etc., $6 and $4; new curb, 90 cts. and 80 cts.; old curb, 15 cts. and 10 cts.; concrete, $10; paving, $25.75 and $21.80; totals, $25 600 and $2,266.50.

Granite paving on 20th St. and Clark Ave.: Julius A. Schneider; removing old paving, preparing roadbed, etc., $6 per square: new 4-in. curbing, 90 and 87 cts. per lin. ft.; old curb reset, 20 cts. per lin. ft.; hydraulic cement concrete, 8-ins. deep, laid complete, $10 per square; granite block paving, $34 and $31.75 per square; totals, $16,223.40 and $8,271.38.——Cass Ave., Allen & Vieths; removing old paving, etc., $3.45; new and old curbing 90, cts. and 20 cts.; concrete, $10; paving, $35; total $49,933.50.——Broadway; Stifel & Ruckert, removing old paving, etc., $8; new and old curb, 90 and 20 cts.; concrete, $12; paving, $28.50; total, $49,020.60.——Approaches to E. Jefferson Ave. bridge: Stifel & Ruckert, removing old paving, etc., 75 cts.; new curb, $1.45; concrete, $12; paving, $31; brick sidewalk, 70 cts.; total $7,765.75.

Railway Work.—The following are the prices of bids for the work of depressing the tracks of the New York Central & Hudson River R. R. at Harlem, on the Harlem division. The prices of the engineer's estimate were given on page 280. WALTER KATTE is Chief Engineer:

No.	Bidders.	Masonry. Eth Ex.	Solid Rock	Lo'se Rock	Ext'a Haul	1st Cl.	2d Cl.	3d Cl.	3d cl. dry.	4th cl. cemt	4th cl dry.	Con. crete	Brk'k Wo'k	Lo'se St'ne	Fil.	Pud. E'rth	Timber. Yell. Pine.	Wh'e Pine.	H'm lock.	Wt. Iron.	Bolts Wsh etc.	Cast Iron.	Ballast-ing.	Ballast on cars.	Ex. Rock	Total.
		cts.	$	$	cts.	$	$	$	$	$	$	$	$	$	cts.	$	$	$	$	cts.	cts.	cts.	$	$	$	$
1	M. S. Coleman	24	1.50	.75	.02	45.00	8.00	5.00	4.00	4.50	3.50	6.00	20.00	1.25	20	1.50	35.00	40.00	20.00	.05	.05	.03	1.25	1.00	.25	1,272,128
2	Sherman & McDonough	33	1.55	.80	.009	28.00	8.50	6.50	5.50	5.50	4.50	6.50	18.00	2.00	27	.85	37.00	40.00	22.00	.05	.05	.05	.95	1.50	1.25	1,277,018
3	Smith, Rigley & Co	26	1.40	.65	.01	45.00	8.00	7.00	5.50	5.00	4.50	6.00	20.00	2.50	23	1.00	33.00	38.00	26.00	.05	.04	.04	1.40	1.10	.15	1,303,224
4	Clark & Westbrook	42	1.50	.45	.01	34.00	8.30	6.00	5.00	5.00	4.00	5.00	21.00	2.00	23	1.00	30.00	40.00	20.00	.04	.04	.03	2.00	1.25	1.00	1,314,890
5	John P. Andrews	29	1.25	.75	.01	40.00	8.20	5.00	4.00	4.00	3.00	6.00	20.00	2.50	27	1.10	32.50	36.00	24.00	.06	.05	.03	1.55	1.10	1.89	1,394,738
6	John Cox & Co	33	1.45	.95	.007½	36.45	8.97	6.00	4.50	5.00	4.00	5.62	18.00	2.00	37	.37	31.00	32.00	24.00	.05	.04½	.03	.47	1.60	2.50	1,410,388
7	John F. Dwyer	41	1.80	.83	.01½	47.00	9.50	6.50	6.50	6.50	4.50	6.00	20.00	2.50	25	.75	35.00	40.00	25.00	.05	.05	.04	.60	1.40	.25	1.4 2,440
8	Arnold & Stephens	40	1.60	1.00	.01	25.00	10.00	6.50	5.50	5.00	4.50	5.00	18.00	3.00	25	.95	32.00	38.00	25.00	.06	.05½	.04½	.50	2.00	4.50	1.4 5,000
9	Sweet & Shanahan	42	1.65	1.00	.01	50.00	12.00	6.00	6.00	6.00	3.30	6.00	15.00	1.50	25	.40	41.80	41.80	30.00	.05½	.05	.04½	.75	2.00	1.50	1,505,230
10	Baird, Lacy & Co	27	1.75	1.10	.01	30.40	10.00	7.80	6.75	6.90	5.00	6.00	20.00	2.00	25	2.00	50.00	50.00	25.00	.06	.04	.04	1.50	1.25	.80	1,532,607
11	Hartland & Co	35	1.75	1.10	.01	27.00	12.00	7.00	5.50	6.00	5.00	6.00	19.00	2.75	20	.75	38.00	50.00	25.00	.05	.03½	.03	1.75	1.35	.50	1,541,875
12	Jos. Richardson	32	1.25	.75	.005	35.00	10.00	7.00	5.75	6.00	4.00	5.60	17.40	1.75	30	1.50	38.00	50.00	30.00	.05	.05	.04	1.50	1.25	1.62	1,750 732
13	Thos. Rutter & Co	45	1.50	.75	.01	35.00	10.00	6.75	5.75	6.00	4.25	6.00	20.00	2.00	30	2.00	50.00	45.00	20.00	.06	.04½	.04½	2.00	1.50	1.00	1,635,066
14	A. Van Wagner & Co	40	2.50	1.00	.01	30.00	10.00	7.50	6.00	6.00	4.25	6.00	20.00	2.00	30	2.00	50.00	45.00	20.00	.06	.04½	.04½	2.00	1.50	1.00	1,750,166
15	Smith & Plunkitt	55	2.00	.85	.009	38.00	10.50	6.75	5.50	6.50	4.75	6.50	21.00	1.00	28	2.00	38.00	47.00	30.07	.04½	.04	.04	1.80	1.65	.60	1,764,836
16	Miles Tierney	60	2.00	.90	.009	50.00	12.00	6.50	5.50	5.50	4.75	6.50	23.00	1.40	20	.90	38.00	45.00	25.00	.04	.04	.04	1.88	1.65	1.00	1,794,836
17	A. M. Newton & Co	74	2.35	.80	.01	65.00	10.35	6.50	6.50	6.50	5.00	6.50	18.50	2.25	30	.90	40.00	40.00	20.00	.06	.06	.04	1.75	1.35	.75	1,875,340

Jail.—M. Artope, of Macon, Ga., has the contract for the jail at Louisville, Ga., for $4,400.

Fire Engines.—The Fire Commissioners, Baltimore, Md., have awarded contracts to Clapp & Jones and the La France Co. for one steam fire engine each, at $4,000 each.

Granite Blocks.—The following proposals for Belgian blocks have been received by the Street Committee, Charleston, S. C.: Winnsboro Granite Co., of Charleston, $1.51½ per sq. yd., $50.34 per 1,000; W. H. Pearce, of Greenwood, $63 50 per 1,000. The contract was awarded to the Winnsboro Granite Co.

Water Bonds.—The $200,000 water bonds for the additional water supply of Albany, N. Y., have been sold as follows: Hudson Savings Institute, $20,000 at $1.00¾; F. Glockner, $10,000 at $1.00¾; Geo. M. Hahn, $170,000 at $1.00½ for 1890 to $1.03¾ for 1907.

Breakwater.—The following proposals for extending the New Haven breakwater were opened April 21 by Lt. Col. D. C. HOUSTON, U. S. Engineer Office, New York City: S. & E. S. Belden, Rocky Hill, Conn., $1.16 per ton of 2,240 lbs.; John Beattie, Leete's Id., Conn., $1.35; C. H. Edwards, Quincy, Mass., $1.50; A. M. Newton, New York, $1.60.

Sewer Material.—At Worcester, Mass., contracts have been awarded as follows: cement, Smith & Green, $1.35 per bbl.; pipe, A. B. Lovell and James Draper; manholes and covers, Caleb Colvin, $9.75 per set, with covers alone at 2 cts. per lb.; catch basin stone, $9.70 per set; brick, Brookfield Brick Co., $7.24 per 1,000.

Drainage.—The following proposals for constructing the temporary drainage of basin at Belmont and Hinsdale Sts., 26th Ward, Brooklyn, N. Y., have been received by JOHN P. ADAMS, Commissioner of City Works: John Hart, 12 and 15-in. cement pipe, $1.27 and $1.45 per ft.; manholes, $36 each; street basins, $110 each; open drains, 38 cts. per ft. Daniel J. Crimm, 85 cts. and $1.30, $34, $100, 40 cts. John S. Bogert, 85 cts. and $1.25, $33 $100, 10 cts. John Bray, 83 cts. and 83 cts., $34, $85, 10 cts.

Asphalt Paving.—The Warren Scharf Asphalt Paving Co., of New York, has the contract for paving Market St., Chattanooga, Tenn. The company gives a 5 years guarantee and will establish a plant and begin work at once. The prices are as follows: laying Trinidad asphalt pavment, $2.85 per sq. yd.; granite blocks $2.75; 2-in. granite curbing, $1 per lin. ft.; 6-in. limestone, curbing, 70 cts.; redressing and resetting old curbing, 20 cts.; repairing openings made for pipe laying, etc., $3.13 per sq. yd.

Dredging.—The following proposals were opened April 21 by Lt. Col. D. C. HOUSTON, U. S. Engineer Office, New York City: In East Chester creek, N. Y.: Michael H. Flannery, New York, 45 cts. per cu. yd.; Hartford Dredging Co., Hartford, Conn., 45 cts.; James McSpirit, Jersey City, N. J., 47½ cts.—In Bridgeport harbor, Conn.; Henry DuBois' Sons, New York, 14 cts. per cu. yd.; A. J. Beardsley & Son, West Stratford, Conn., 14½ cts.; Hartford Dredging Co., Hartford, Conn., 16 cts.; Townsend & Fennell, Boston, Mass., 19 cts.

Paving Blocks and Curbstones.—The following proposals have been received by C. M. SLOCUM, City Engineer, Springfield, Mass.: G. E. Lyons, Greenfield, Mass.; blocks, $1.80 per sq. yd.; 4 and 6-in. curbstones, 40 and 55 cts. per lin. ft. Webb & Batchelder, Worcester, Mass., blocks, $1.90; curbstones, 40 and 50 cts. Bidwell & Cooper, Chester, Mass., blocks, $1.58. W. N. Flynt Granite Co., Monson, Mass., curbstones, 40 and 50 cts. Chester Granite Co., Chester, Mass., curbstones, 40 and 50 cts. The contract for blocks was awarded to Bidwell & Cooper, and for curbstones to the Chester Granite Co.

Sewers.—***Montgomery, Ala.***—The following proposals were received April 16 by the City Council: Howland & Ellis, Boston, Mass., $41,762.71; J. A. Gaboury, Montgomery, $41,724.13; J. J. Everson, Akron, O., $40,894.25; H. Brooks, Jackson, Mich., $35,644.16; Figh & Ball Montgomery, $32,202.96; A. Pennel, $57,925.56. The contract was awarded to Howland & Ellis. The work is for the construction of the central division of the general sewer system and comprises the following: brick sewers, 6,518 lin. ft. of 24x36, 60 ft. of 18x27 and 948 ft. of 16x24; pipe sewers, 2,823 lin. ft. of 18 in., 582 ft. of 15 in., 1,236 ft. of 12-in., 2,214 ft. of 10-in., 7,916 ft. of 8-in.; 45 manholes, 6 of which will be rigged for flushing. W. G. WILLIAMSON, City Engineer.

St. Louis, Mo.—The Board of Public Improvements has awarded contracts as follows: Sewer in Ohio Ave., Sewer District No. 15; F. Skrainka, earth and rock excavation, 35 cts. and $3 per cu. yd.; brick masonry, $7 per cu. yd.; 12, 15 and 18-in. pipe, 90 cts., $2, $2.75 per ft.; 6 and 12-in. junctions, 60 cts. and $1 each; inlet stone, 70 cts. per sq. ft.; cast and wrought-iron, 3 cts. and 6 cts. per lb.; total, $12,300.90.—Sewer in Warren Ave.; G. Prendergast earth excavation, 24 cts. per cu. yd.; brick masonry, $6.50 per cu. yd.; 6, 12 and 15-in. junctions, 45 cts., $1 and $1 each; cast and wrought-iron, 3 and 5 cts. per lb.; total, $8,084.61.—Sewers on 12th and Wright Sts.; J. Casey, earth excavation, 25 cts.; brick masonry, $6.50; 12 and 15-in. pipe, 70 and 85 cts.; 6, 12 and 15-in junctions, 40 cts., 75 cts., $1.50; cast and wrought-iron, 3 and 4 cts. per lb.; total, $1,706.50.

Water Pipe.—The following proposals for 896 tons of cast-iron pipe and 22 tons of special castings, have been received by E. M. BIGELOW, Chief of Department of Public Works, Pittsburg, Pa.: Addyston Pipe & Steel Co., Cincinnati, O.: 4, 6, and 8 in.; $29 98 per ton; 8, 10 and 12-in., $28.88; specials, 2¼ cts. per lb., $45 per ton. National Foundry & Pipe Works, Scottdale, Pa.: 4-in., $28.25; 6 in., $27.10; 8-in., $27; 10-in., $26.15; 12-in., $25. Lake Shore Foundry, Cleveland, O.; 4-in., $28.15; 6-in., $27.35; 8-in., $27.15; 10 and 12-in., $26.45; specials, 2½ cts., $50. Buffalo Cast Iron Pipe Co., Buffalo, N. Y.; 4-in., $28.70; 6 and 8-in., $27.90; 10-in., $27.44; 12-in., $27; specials, 2¼ cts., $50. Ohio Pipe Co., Columbus, O.; 4-in., $27.93; 6 and 8-in., $26.83; 10 and 12-in., $26.43; specials, 2¼ cts., $55. McNeal Pipe Co., Burlington, N.J.; pipe, $28; specials, 2¼ cts., $55. Fisher Foundry & Machine Co., specials, 2 4 cts., $48. Wm. Yagle & Co., Pittsburg, specials, 2.47½ cts., $49.50. The contract for pipe was awarded to the National Foundry & Pipe Works, and for specials to the Fisher Foundry & Machine Co., of Pittsburg.

Water Bonds.—The following proposals for the purchase of $75,000 5% refunding water bonds, payable in 10, 12 and 13 years from May 1, have been received by the Board of Water Commissioners, East Saginaw, Mich.: New Bedford Inst. for Saving, New Bedford, Mass., 104 and bonus of $5 for the 10 years bonds, if accompanied with certificate of official census. Woodbury & Moulton, Portland, Me., $750 premium for the entire issue. Brewster, Cobb & Estabrook, Boston, Mass., 102.27 for the entire issue, and 105.63 if official census is furnished. R. E. Day & Co., Boston, Mass., 102.145 for the entire issue. Savings Bank of East Saginaw, par for the 10 year bonds. John E. Harper & Co., Detroit, 2½% premium for $10,000. W. W. Crapo, New Bedford, Mass., $500 premium for the 10 year bonds. Peoples' Savings Bank, East Saginaw, par for $20,000. W. J. Hayes & Sons, Cleveland, O., $77,300 for the entire issue. N. W. Harris & Co., Chicago, Ill., $77,321 for the entire issue. Spitzer & Co., Toledo, O., (withdrawn). The bonds were sold to N. W. Harris & Co.

Proposals Open.

Railroad.—Eureka Flats and Heppner branches of the Oregon Railway & Navigation Co. Kilpatrick Bros. & Collins, contractors. Apply to E. T. Johnson, at Wallula, Wash. Ty. May 1.

Bridge.—wrought-iron bridge, 2 spans of 92 ft. each, 24 ft. roadway, 20 ft. sidewalks, capacity 100 lbs. per sq. ft. H. W. Welch, Road Commissioner, Clinton, Mass. May 1.

Bridge.—Masonry for undergrade bridge at Church St., Frankford, Pa. Similar to bridge over Broad St., same place. Wm. H. Brown, Chief Engineer, Pennsylvania R. R., 233 S. 4th St., Philadelphia, Pa. May 1.

Asphalt Walks and Cobblestone Roadways.—About 2,308⅝ sq. yds. of asphalt walks and 4,144 sq. yds. of cobblestone roadways at Fort Myer, Va. G. B. Dandy, Dep. Q. M. Gen., U. S. A., Washington, D. C. May 2.

Pumping Engines, Pipe Laying, Etc.—Two horizontal plunger, duplex, compound, condensing engines, outside packed, daily capacity 5,000,000 galls. delivered 250 ft. high with piston speed not exceeding 100 ft. per min. Laying 19,920 ft. of 6, 8, 10 and 16 in. pipe. Iron fire plugs and stop gates, from 4 to 20 ins. Cleaning old water mains, 4 to 12 ins. James Brown, Comptroller, Allegheny, Pa. May 2.

Street Work and Sewer.—The Commissioner of Public Works, 31 Chambers St., New York City. May 2 and 7.

Sewer.—Rebuilding 24-in. sewer through reservoir dam at St. Johnland, L. I. J. F. Carey, Engineer. The County Farm Committee, Board of Supervisors, County Court House, Brooklyn, N. Y. May 3.

New Croton Aqueduct.—Furnishing and laying 48-in. cast-iron pipe, etc., from 135th St. and Convent Ave. to the gate house of Central Park reservoir. James C. Spencer, President, Aqueduct Commissioners, 280 Broadway, New York City. May 9.

Sewers.—Furnishing and laying 595 lin. ft. of 22×32 brick sewer. Laying pipe sewers (pipe furnished by the borough), 2,880 ft. of 24-in., 620 ft. of 20-in., 235 ft. of 18-in., 650 ft. of 16-in., 1,275 of 8-in.; also 24 manholes. W. G. Smith, Engineer. John M. Hall, Chairman, Special Sewer Committee, Willimantic, Conn. May 14.

Water-Works.—Inlet and river work, also engine house and engine foundations. For quantities of materials and other particulars see advertising pages. Charles R. Long, President, Louisville Water Co., Louisville, Ky. May 15.

Bridge.—Repairing Chattahooche River bridge. S. D. Coleman, Mayor, Fort Gaines, Ga. May 16.

Sewerage System.—Excavation, manholes, flush tanks, pump well, pump house, artesian well, filth chamber and hoist pumping machinery. W. F. Lange, Deputy, City Auditor's Office, Aberdeen, Dak. May 21.

Timber and Bolts.—For Harlem river improvement. Round hemlock, 36,000 lin. ft.; round spruce, 4,600 lin. ft.; 10 × 10 yellow pine, 8,000 ft. B.M.; 10,000 lbs. of ⅝ × 16-in. drift bolts. Lt. Col. G. L. Gillespie, U. S. Engineer Office, New York City. May 3.

Street Work.—Henry Flad, President, Board of Public Improvements, St. Louis, Mo. May 7.

Pipe and Castings.—About 1,185 tons of 36 in. and 48-in.; also about 1,855 tons of 6, 8, 10, 12 and 15-in. cast-iron coated water pipe; specials, 166 tons. Henry Flad, President, Board of Public Improvements, St. Louis, Mo. May 7.

Pipe.—For 500 6-in. A water pipes. D. P. Rowland, Commissioner of Supplies, City Hall, St. Louis, Mo. May 7.

Street Work.—Excavating, filling, flagging, curbing and cobblestone paving. Thos. J. Lanahan, Clerk Board of Contract & Apportionment, Albany, N. Y. May 7.

Railway Track Material.—For 156 tons of 50-lb. steel rails, 1,500 steel angle plates, 3,200 track bolts with Harvey lock nuts, 10,500 lbs. track spikes, 5 steel split switches, 5 steel frogs, 5 ground lever switch stands, 5,700 creosoted yellow pine ties, railroad tools, lumber, etc. James Fulton, Paymaster General, U. S. N., Navy Department, Washington, D. C. May 8.

Sewers.—Stoneware vitrified pipe sewers, 6, 12, 15 and 18-in., catch basins, branches, excavation, etc. Charles N. Wood, Engineer. John D. Kimmey, Chairman of Sewer Committee, Norwalk, Conn. May 7.

WATER.

The Arkansas Valley Irrigating Canal Co. has been incorporated at Dodge City, Kan., with a capital stock of $300,000.

Wheeling, W. Va.— April 10, 1888.

EDITOR ENGINEERING NEWS: We are about to build a reservoir of 3,000,000 galls. capacity.

H. P. WILLIAMS, *Secy., Water Board.*

Fairhaven, Mass.—

NEW BEDFORD, MASS., April 14, 1888.

EDITOR ENGINEERING NEWS: Work will begin May 1 on a system of water works for Fairhaven, Mass. Water will be pumped from wells to a stand-pipe. The cost of the works is estimated at $50,000, and they will be built by the Fairhaven Water Co. O. G. STANLEY is the engineer in charge of survey and construction.

JOS. K. NYE, *President.*

Irrigation in California.—The Mountain Glen Land & Water Co. has been incorporated at San Diego, Cal., to develop the Mountain Glen tract of land in San Diego Co. C. B. HEWITT, Los Angeles; L. S. PORTER, Pasadena. Capital stock, $40,000.—A project is on foot for the irrigation of a large district in Yuba Co., north of the Yuba river and embracing the foothill region. Landowners propose to induce a stock company to construct irrigation works by issuing bonds upon their lands to cover the cost, at the rate of about $2 per acre. ——The flume which has been built to carry water to San Diego will be extended into the Cajon valley and water supplied for irrigating the ranches in the valley.

Artesian Wells in Iowa.—***Burlington.***—The daily papers are urging the artesian well company, which has been lying low for some months, to get to work.

Boone.—The well is down about 600 ft. and is now in sandstone.

Ottumwa.—The Ottumwa Development Co. has its well down 2,042 ft. and has stopped work as the contract called for 2,000 ft. The contractor was P. F. Kearnes, who was paid $6,000. A good supply of water has been developed.—Mr. Kearnes has contracted with the Iowa Water Co. (S. L. WILEY, President), to bore two wells, 1,100 and 1,500 ft. deep; they will be 8 ins. diameter at the top, reducing to 5½ ins. The wells are for the city water supply, and there is much satisfaction expressed at the action of the water company.

Cedar Rapids.—The artesian well is down about 1,430 ft. and is now in hard flint rock. There is a flow of 250 galls. per minute.

Vinton.—The experimental well is down about 1,900 ft. and is now passing through slate. There is a considerable flow of water.

Washington, Mo.—The following particulars respecting the proposed water-works are taken from a circular issued by the Water-Works Committee. The city will grant a franchise for 20 years. The supply is to be drawn from the Missouri river at a point where the water will be pure, and pumped to settling reservoirs with a combined capacity of 150,000 galls.; in place of one or all of these reservoirs, filters of approved design may be provided. The reservoirs or filters to be capable of properly purifying all water used for domestic consumption. The pumping machinery is to have an aggregate daily capacity of not less than 1,500,000 galls., and is to be in two or more separate sets so that in case of accident or repairs the city will not be without fire protection. There will be about 4 miles of 4, 6, 8 and 10 in. pipe, and about 40 hydrants; the latter being 6-in. post, 2½-in. double discharge, with frost jackets and 4-in. connection. An elevated iron tank or stand-pipe to be put up, capacity not less than 100,000 galls. The test is to be two 1-in streams to a height of 60 ft. by stand-pipe pressure, and four 1-in. streams to a height of 100 ft. by direct pressure. The works to be kept in good condition and extensions to be made as required. The city reserves the right to purchase the works at an appraised valuation at the end of 10, 15 or 20 years. Bidders may propose modifications of the plans outlined. Proposals to state hydrant rental to be paid by the city, prices to be charged for water for general purposes, and a detailed statement of the proposed work. Population 5,000. Address all communications to W. H. HAGEBUSCH, Clerk of Water-Works Committee. Proposals will be received till May 19.

Drainage Siphon.—W. G. WILKINS, C. E., has taken the contract for making the official map and surveys for the borough of Wilkinsburg, Pa. He has also prepared plans for drainage for the property of the South Fork Fishing & Shooting Club at Conemaugh lake, which will include a 6-in. wrought-iron siphon, 4,800 ft. long, to carry sewage over the dam.

Los Angeles, Cal.—The franchise of the Los Angeles Water Co. expires in 1897. It has nearly ten years to run. The terms of the franchise are that, at its expiration, appraisers shall be selected by the company and the city and they shall appraise the value of the pipes and other materials connected with the system and the city will become possessed of the same on payment of the appraisement.

Coney Island, N. Y.—The completion of the water-works and sewerage systems is to be celebrated May 23 with some ceremony. The sewer and water systems will cost the town about $35,000. Ten acres have been secured for the driven wells, of which there are 200 on the Andrews system. Three miles of water pipe run through the island and of the 100 hydrants to be placed 50 are already set. Water is kept in the pipes and the pressure will be direct from the wells, the sewer engines furnishing the power.

Chicago Lake Tunnel.—Work is progressing on the shore end of the new lake tunnel for the Chicago water supply, but the city engineer is now making borings on the lake front in order to locate a new site for the shaft, the former site, where work was commenced, having been abandoned in consequence of the extensive quicksand pocket that was struck. On the shore tunnels the work is being pushed in 5 directions from 3 shafts; the shafts are 74 ft. deep and 10 ft. diameter. The tunnels are 7 ft. in diameter with a 12-in. brick lining.

Water-Works.—*New Hampshire.*—Milford. Water-works are to be established. Address M. S. Hall.——Dover. The plans for the new water-works have been prepared by PERCY M. BLAKE, C. E., of Hyde Park, Mass. The Camden Iron Works, Philadelphia, have the contract for pipe and castings, at $68,950.

Connecticut.—East Hartford. The East Hartford Water Co. has received the report from ROBERT A. CAIRNS, C. E., of Troy, N. Y., on the new water supply. The springs at Burnside are recommended as the source. The plan includes one or more wells, a pumping station, a force main and distribution mains, and a stand-pipe 12 ft. diameter and 100 ft. high, with a capacity of 85,000 galls. About 40 hydrants will be placed.

New York.—Brooklyn. City Commissioner ADAMS has forwarded to the Board of Aldermen the estimate of the expense of supplying the city with water for the ensuing year. He places the amount at $500,527, an increase of $40,000 over the appropriation for the past year.——Troy. Superintendent BAKEMAN'S report states that the combined supply from the gravity and pumping systems is ample. During the year 5,990 ft. of pipe have been laid and 22 hydrants and 34 valves set. The consumption for the past year was about 3,000,000 galls.

New Jersey.—Newark. The Aqueduct Board has again been discussing the question of an additional water supply. A committee has been appointed to ascertain what sources of supply are now available, and to obtain propositions from various water companies; Mayor HAYNES is Chairman, and Commissioners KUHN and WISMER, and Aldermen KETCHAM and DURYEE, are the members of the committee.

Pennsylvania.—Holmesburg. The Holmesburg Water Co. has asked the City Council of Philadelphia for permission to lay pipes in the streets of Holmesburg, Director WAGNER having stopped their work on certain streets.

Maryland.—Cumberland. The Baltimore & Ohio R. R. is putting down an artesian well.

Delaware.—Wilmington. The artesian well of the Hartmann & Fehrenbach Co. has reached a depth of 815 ft., and has about 800 ft. of water. The well is 8 ins. diameter.

Ohio.—Cambridge. The Council held a meeting April 16 to consider the bids received for the construction of the water-works. Only one bid was received, and as half of the Council will go out May 7 it was decided to do nothing in the matter until the change of members is made.

Kentucky.—Owensboro. A serious fire occurred April 15, but the fire department could render no service, as the water-works were not pumping, having shut down in the afternoon without notifying the city. The Louisville *Courier-Journal* says: "The water-works were finally got in order, and did magnificently, but not until all hope of saving the buildings had been abandoned. The works came in for the usual amount of cussing, and well did they deserve it as they were shut down yesterday afternoon without any notice to the city. And to this carelessness should the blame be attached for the great damage done. Had the department been given notice of the intended suspension they could have had the engine ready. The water-works are owned by Louisville parties."

Tennessee.—Bessemer. The water-works are completed and ready to be put in operation.

Illinois.—Peoria. A new system of water-works is needed, the present works being inefficient. The Peoria *Transcript* says: "Once more has the inefficiency of Peoria's water-works system been demonstrated, and again has it been proved that the steamers are our only dependence in cases of fire. The universal opinion is, that without these the city is practically without defense in cases of conflagration. The feeble streams from the hydrants would scarcely quench a burning brush heap. These object lessons—costing about $100,000 each—come high, but it seems that Peoria must have them. We should have, and that as quickly as possible, a new system of water-works by which a hydrant stream could reach the tops of the highest buildings."——Staunton. A tract of 50 acres has been secured for the reservoir site and the work of clearing it has been let at $9 per acre. Proposals are being received for a dam.——Ipava. Work is progressing on the artesian well.

Iowa.—Mount Pleasant. The water company, which is composed of New York parties, has appropriated $30,000 for putting in new mains, extending the works and introducing the Hyatt filter to purify the supply from Big creek. Col. Phillips, of Springfield, Mass., is President.

Kansas.—Udall. Work is progressing on the new water-works. The trenching and pipe laying is going on rapidly.

Montana.—Helena. At the test on April 14, the pressure was 155 lbs. at starting, and ran up to 170 lbs. The streams were thrown from the pump. When the reservoir is completed, which it will be in May, the pressure will be greater. There are 16 miles of pipe.

Oregon.—Eugene. The water-works company is extending its mains, and is getting a large number of new consumers.

California.—National City. The completion of the water-works and the Sweet Water dam, was celebrated April 20, with appropriate ceremony. The reservoir, the dam for which was commenced in November, 1885, is 3 miles long and ¾ mile wide, covering 700 acres. It has a capacity, of 6,000,000 galls.——Folsom. A water supply and water power is to be obtained by a canal from the American river. The canal will be 6 ft. deep and 32 ft. wide. It will be used for irrigation purposes also, and will be made by convict labor.

Texas.—Fort Worth. A satisfactory test of the new gang wells was made April 11. There are 115 wells.——Galveston. J. W. Byrnes, the contractor for the artesian well for the Texas Ice & Cold Storage Co., has struck water at 836½ ft., with a 6-in. pipe.

Annual Reports.

Ottawa, Ont.—The Water-Works Committee has issued its report for 1887. The Manager recommends that the pump-house, forebays, etc., be enlarged to contain two additional sets of machinery, one set to be erected before 1890; the machinery to be similar to that now in use, which has given very satisfactory results for 12 years. He also recommends the laying of a duplicate 15-in. main connected with the present submains and so arranged that one set of machinery can supply the Government buildings and the summit levels at steady high pressure, leaving the other set to supply, except in case of fire, the lower portions of the distribution system at a reduced domestic pressure, the present pressure being higher than necessary; additional 8-in. mains are also recommended. The cost of these improvements is estimated as follows: enlargement of pump-house, etc., and 1 set of machinery, $45,000; new 15 and 12-in. main, $19,670; extension of distribution system, $15,330; total, $80,000. Expert opinions are quoted to show that the epidemic of last year cannot be attributed to the water supply from the Ottawa river. The total amount of water pumped was 1,763,609,000. During the year 9.176 miles of pipe were laid, and 49 hydrant and 180 stop valves set. There are now 58 742 miles of pipe, 413 hydrants and 492 stop valves. ROBERT SURTEES is Manager.

London, Ont.—The Water Commissioners have issued their report for 1887, being their 9th annual report. An increased supply is necessary, as last year the springs proved inadequate and lawn sprinkling had to be prohibited and the supply to the Grand Trunk Ry. shut off. The additional supply from Dufton springs, although considerable, will not be sufficient for the demand. The works and the pumping machinery, both steam and hydraulic, are in good condition. The addition of the water from Dufton springs, 200,000 galls. per day, increases the present supply about 10 per cent., but as the number of consumers increases in about the same ratio, this will only provide for 1 years' increase so that the scarcity of water will be as badly felt this summer as it was in that of 1887; under these circumstances the superintendent urges that an additional supply is an absolute necessity. About 7,000 ft. of 4 and 6-in. pipe were laid during the year. T. H. TRACY is Superintendent and Chief Engineer.

Fredericton, N. B.—The Water Committee has submitted its report for the year ending Oct. 31, 1887, being the 5th annual report. During the year 642 ft. of 2-in. pipe was laid, 1 hydrant and 11 gates; also 68 new services. There are 9 miles 183 ft. of 3 to 12-in. cast-iron pipe and 3,801 ft. less than 3 ins.; 4 miles 334 ft. of ¾-in. to 2-in. enamelled and galvanized iron service pipe, 603 services (382 in use), 766 service taps, (740 in use), 81 hydrants, 113 stop gates and 4 blow-off gates. Average length of service, 38½ ft.; average cost, $12.91. There are 588 families supplied, averaging 5 persons to each family. The total amount of water pumped was 123,414,444 galls. ALEX. BURCHILL is Superintendent.

Bridgetown, Nova Scotia.—The Commissioners of Water Supply have issued their first annual report and financial statement; the same being for the year ending Feb. 6, 1888. In the fall of 1886 the first practical steps were taken in regard to the establishment of a water supply. An act was passed by the Legislature, a loan of $18,000 was obtained from J. C. MACKINTOSH, of Halifax, at 5 per cent. interest and 1 per cent. commission, and proposals for construction were then advertised for; 4 proposals were received and the contract was let to Sutherland & Cochran. The pipe and gates were purchased in Scotland, and the hydrants were supplied by the Windsor Foundry Co. There are 3,200 ft. of 8-in. pipe, 10,475 ft. of 6-in., 3,875 ft. of 4-in., and 400 ft. of 3-in.; 22 hydrants and gates. The supply is taken from 3 springs with an aggregate daily capacity of 200,000 galls. in dry seasons, the supply being ample for many years to come. The reservoir is about 70 rods below the springs and has a capacity of 750,000 galls.; this can be increased by raising the dam. The Commissioners compliment Mr. A. W. FORBES, the engineer, on his work. The engineer's reports contain the prices of the work and estimates for laying pipe across the Annapolis river; the latter amount to $350 if carried over the bridge, and $275 if laid on the bed of the river, using Ward's ball and socket joint. JOHN E. SANCTON, JOHN ERVIN and DANIEL PALFREY are the Commissioners.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of Water-Works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

MILFORD, N. H., April 21, 1888.

EDITOR ENGINEERING NEWS:—At the last session of our Legislature a charter was obtained to construct a system of water-works in this town. At the annual town meeting held March 16, 1888, the Selectmen were instructed to contract within 90 days for a plant to include 40 hydrants. The source of supply has not been determined. We are in hopes to find a gravity supply, but otherwise the supply will probably be from wells. This will be in addition to our present system which consists in pumping from the Souhegan river to a reservoir, and is for fire protection only. I shall be pleased to give you further information when the contract is concluded.

WM. M. KNOWLTON,
President Milford Water Co.

SHERBURNE, N. Y., April 23, 1888.

EDITOR ENGINEERING NEWS:—We are about to build a new reservoir with a capacity of about 30,000,000 galls.

W. E. DAVIS,
Supt. Sherburne Water-Works.

JAMESTOWN, N. Y., April 20, 1888.

EDITOR ENGINEERING NEWS:—We are building a new pumping station four miles east of the present system, where we have four artesian wells 8 ins. in diameter, yielding 2,000,000 galls daily. We are putting in 16-in. pipe to connect the above with our present system, and extending our mains about three miles in town. Total cost of new work, about $100,000. We expect to have it in working condition by July 1.

A. F. KENT,
Supt. Jamestown Water Supply Co.

HAMMOND, Ind., April 20, 1888.

EDITOR ENGINEERING NEWS:—Work was begun April 18 on a system of water-works for this town, and will be finished June 20. The contractors are E. B. WINGATE and JNO. GUBBINS, both of Chicago. The population of our town is 4,000, the works will cost $50,000, and the money is already secured by bonds. Water will be pumped from a well to a reservoir and stand-pipe.

H. HALL, *Chairman Water-Works Board.*